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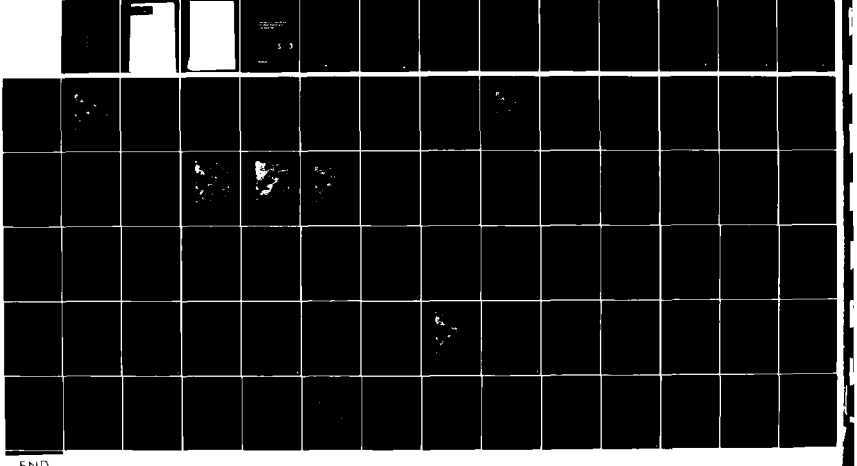

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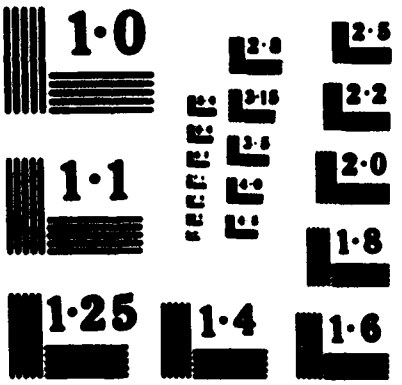
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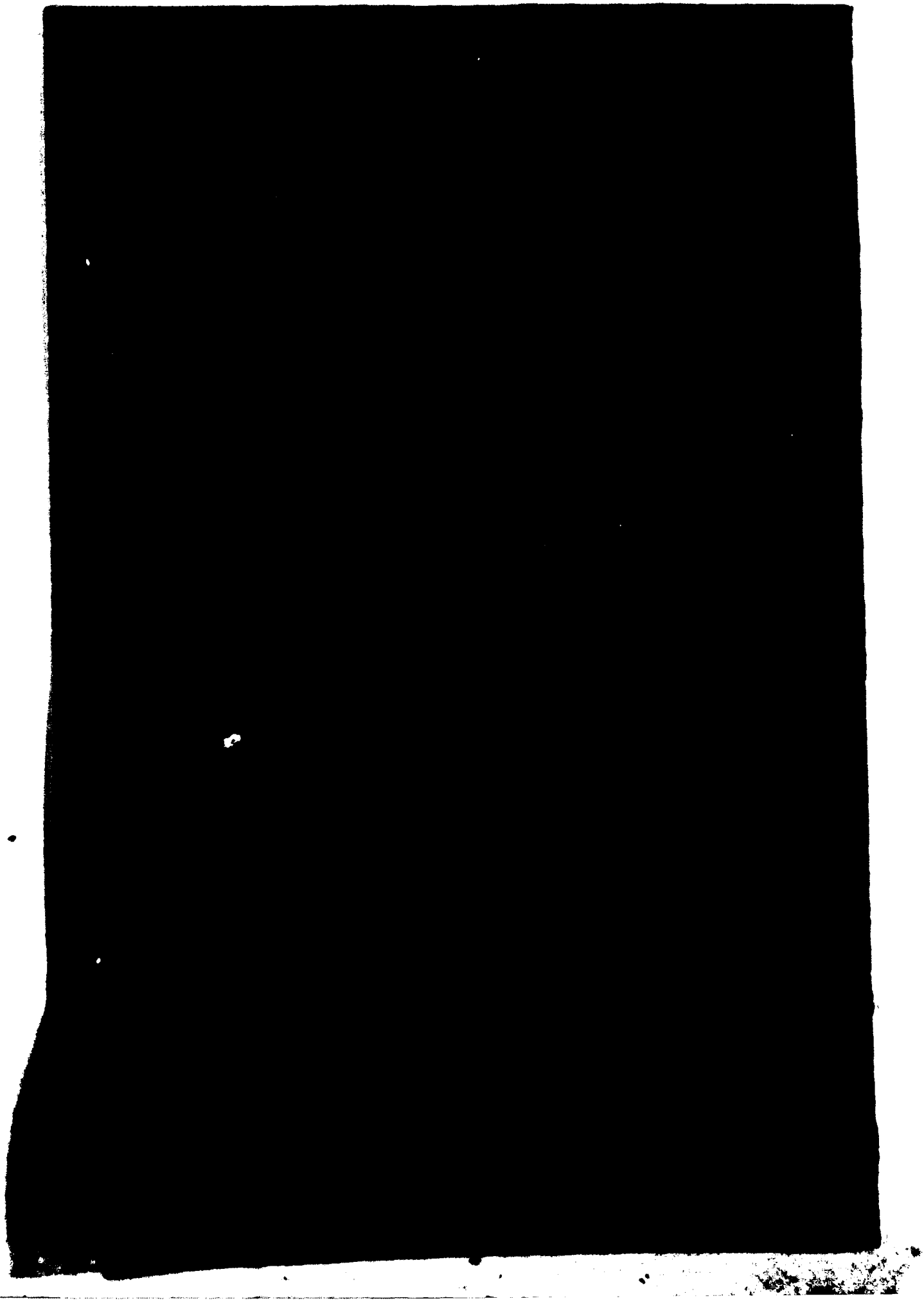

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Concepts of Operations and USAF Planning for Southwest Asia

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A Project AIR FORCE Report
prepared for the
United States Air Force

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PREFACE

Under the Project AIR FORCE study effort, "Strategic Policy for Long-Term Competition," Rand is examining future U.S. national security policy and its implications for the United States Air Force. Recent work has concentrated on fashioning a planning framework that makes use of the coherence among national objectives, strategies, capabilities, and concepts of operations to assist in planning efforts (see G. Kent, "Concepts of Operations: A More Coherent Framework for Defense Planning," N-2026-AF, 1983).

The purpose of this study is twofold. First, it illustrates the application of a planning framework that could lend greater coherence to U.S. security policy and permit the more effective allocation of defense resources. Second, it attempts to provide policymakers with a broad overview of the contribution the United States Air Force could make in protecting U.S. and Western security interests in Southwest Asia.

This report is aimed at the nonspecialist so that it can reach a wide audience in both military and civilian circles. Accordingly, it has been written using unclassified sources. Many of the numbers used for illustrative purposes are only rough estimates, although they fall within the ordinary range of error for numbers of this sort.

SUMMARY

This report illustrates the application of a framework that could lend greater coherence to U.S. security planning. It also attempts to provide policymakers with a broad overview of the contribution the United States Air Force could make in protecting U.S. and Western interests in Southwest Asia.

U.S. major interests in Southwest Asia have assumed almost the same level of importance as U.S. interests in Europe and the Far East. They are located in and around the Persian Gulf, which contains 60 percent of the world's known oil reserves.

The primary objective of the United States in the Persian Gulf area is to ensure that Western nations have continuing access to oil reserves there at a reasonable price. Threats to halt or control this critical flow of oil come from four main sources:

- Politically motivated oil embargoes;
- Attacks by hostile regional powers;
- Internal instability; and
- The possibility of political coercion or direct attack by the Soviet Union.

This study concerns itself with the most demanding military problem—the possibility of a Soviet invasion of Iran aimed at securing control over the oil fields of the Persian Gulf. The time period under consideration is the mid-1980s to the mid-1990s.

The broad national strategy to support U.S. regional objectives contains economic, political, and military elements. The United States has attempted to:

- Reduce its own dependence and that of its allies on Persian Gulf oil by means of a policy aimed at achieving energy self-sufficiency;
- Strengthen its position in the area and the position of friendly regional states through selective military, technical, and economic aid;
- Ease its often strained relations with the vital Arab nations on the Arabian peninsula by moving toward a settlement of the Arab-Israeli dispute;
- Deter a Soviet attack by convincing the Soviets that aggression aimed at securing control over the Gulf would elicit a major U.S. military response that would greatly reduce their chances

of success and present them with the dangers of escalation to a wider, possibly nuclear, conflict.

In developing the military component to this national strategy, the United States examined the nature of the Soviet threat and other important considerations, such as distances, basing for combat forces, and the regional environment. The issues of terrain, logistics, local resistance, and distance would present the Soviets with many problems in invading. The United States would also face many difficulties.

- Southwest Asia is at a great distance from the United States.
- Many areas have a very harsh climate.
- Lack of political support in the region has led to the current U.S. basing policy whereby the United States has been unable to establish peacetime bases for forward-deployed units. Instead, in the event of an emergency, the United States plans to support its forces with the assistance of concerned regional powers from the area's rapidly developing industrial infrastructure and from those facilities where the United States has negotiated "contingency access agreements."

With these strategic considerations in mind, the United States has developed a military strategy that depends upon the rapid projection of forces to the region to enhance deterrence and, should this fail, to begin conducting effective operations. As the Soviets battle their way through Iran's hostile terrain and opposing forces, **the United States plans to establish lodgements of sufficient strength in Iran to stop or push back the Soviet offensive.** To support this "lodgement" strategy, the United States has created the Central Command, which conducts its planning for possible contingencies with varying sized forces from a "reservoir" of forces. The United States has also initiated a series of logistics, mobility, and training programs to alleviate the constraints imposed by distance, lack of basing, and regional environment.

The Air Force would play a critical role in supporting this strategy, particularly if its inherent qualities of speed and effectiveness of response are exploited successfully. Depending in part upon prior deployment, the Air Force could come into action within hours of the order to begin operations in this distant region and each of its primary missions—air superiority, reconnaissance, interdiction, close air support, and airlift—would directly support U.S. military strategy. Providing air cover would ease the insertion of combat forces; reconnaissance would provide vital information to permit the more effective use of U.S. forces; interdiction would provide a means to slow or halt the

advance of the Soviet forces to allow the establishment of credible lodgements further south; close air support would help defend these defensive positions; and airlift would carry in the units needed to create these lodgements.

This strategy places some unique demands upon the services and a great deal of emphasis on airpower. It also points to the need for at least three enhanced Air Force capabilities:

- **Because long range combat aircraft could conduct conventional interdiction operations from bases on the perimeter of the theater, the potential of these aircraft should be fully exploited;**
- **So the United States could begin establishing lodgements more rapidly, U.S. airlift capability should be increased;**
- **To begin conducting operations rapidly from regional bases, strategic mobility of U.S. tactical air assets should be increased,** which would permit the rapid insertion of a deterrent force and, perhaps equally important, ease the redeployment of aircraft within the theater should hostilities commence.

Improving the strategic mobility of tactical aircraft is used to demonstrate a possible concept of operations—a clear plan of how the Air Force could attempt to achieve this capability. Essentially, each tactical aircraft sortie is the product of a complex and interactive system of fuel, munitions, austere-field-capable aircraft, and base kits.

Providing sufficient fuel where needed in Southwest Asia would require:

- The improvised use of existing regional fuel storage tanks, refining plants, pipelines, and offshore mooring points;
- The pursuit of enhanced pre-positioning and sealift;
- The procurement of portable offshore mooring facilities, rubber pipelines (for intra-theater fuel distribution), and fuel bladders; and
- Aerial refueling.

Providing sufficient air-to-air munitions by airlift from the CONUS or other theaters would probably not present many difficulties, but supplying interdiction and ground attack units with heavier air-to-ground munitions by airlift would be very difficult. Accordingly, sealift, pre-positioning, and munitions in the inventory of regional forces would have to be utilized, although supplying a smaller ground attack force by airlift would certainly be possible.

Developing austere-field-capable aircraft would also form an important part of this concept. Regional bases, such as military airfields and international airports, would certainly possess some stocks of fuel, hangars, and beddown space, but few air forces in the area possess modern U.S.-made aircraft and their maintenance facilities. Accordingly, serious consideration should be given to modifying U.S. tactical aircraft to decrease their dependence on specialized base support facilities and maintenance personnel, while remaining at high levels of readiness.

Such modifications could include the installation of on-board oxygen generating units, the use of compressed air instead of nitrogen in tires and struts, the development of self-starting aircraft, the procurement of longer-wearing tires, and the installation of mechanical munitions hoists. Maintenance demands could be eased and ground personnel reduced through such measures as the use of common fasteners and hinges on all access doors, the development of common ground maintenance stands, the use of more durable materials on access doors, increased commonality among landing gear struts (as in the F-16) and flying surfaces (as in the A-10), and many others. Reliability could be improved through the use of "matured" avionics and engines. One overall method of improving the austere-field capability of current aircraft, and one that might appeal to Congress, would be to set up an industry contest or a prototype derivative contest aimed at modifying an existing aircraft.

Such aircraft would permit the development of smaller, lighter, and more rapidly deployable base kits, which probably would be needed to augment local facilities. The current base kit for supporting both personnel and aircraft, known as the Harvest Bare kit, requires a lengthy period to set up: Squadron-level support requires 20 days; wing-level support, 60 days. The portable buildings are of heavy construction, and facilities are more luxurious than required in the initial stages of operations. The planned use of latrines, dishwashers, showers, and air-conditioning creates a demand for large water and electrical power generation and distribution facilities. The other base kit maintained by the Air Force is the Harvest Eagle kit, consisting of lightweight tent cities that can support personnel, but not aircraft.

- **As a near-term measure, combining the Harvest Bare and Harvest Eagle kits would decrease the weight and improve the speed at which aircraft could be deployed—the Harvest Bare kits could provide aircraft**

maintenance shelters and the Harvest Eagle kits could provide personnel and administrative structures.

- As a longer-term measure, some analysis could be directed toward using lightweight high-technology structural materials to develop lighter base kits.
- Examining the use of rear-area maintenance bases on lines similar to the A-10 basing concept in Europe would also aid in reducing the amount of equipment required at forward sites.

The strategic mobility of aircraft would improve if fewer types of aircraft were deployed. The current Air Force contribution to the Central Command "reservoir" consists of five different types of aircraft—F-111s, F-15s, F-4s, A-10s, and A-7s. Each of these requires different spares and maintenance facilities and, except for the F-4s, each would be largely dedicated to a single mission.

One method of increasing commonality and decreasing the amount of equipment that must be transported to the theater would be to designate only two types of aircraft for initial operations. These could include F-111s, which have a lengthy range and can operate both day and night, and a multi-mission aircraft that could carry out both ground attack and air superiority missions, such as the F-4, F-16, or possibly the derivative F-15E or F-16E. The Air Force would then have to support only two different types of aircraft in this demanding theater.

This concept of operations provides aircraft with enhanced mobility. It creates a capability that directly supports U.S. military and national strategies, hence U.S. political objectives in both this and other remote regions. The Air Force must consider many complex and interrelated factors in the case of war with the Soviet Union over the vital oil resources of the Persian Gulf. A deeper understanding of the coherent relationships existing among U.S objectives, strategies, capabilities, and concepts of operations can increase the Air Force's effectiveness in Southwest Asia and make U.S. security planning more effective.

ACKNOWLEDGMENTS

This report draws upon the expertise of many people at Rand and in the Air Force. Not all who contributed can be listed here, but I would like to thank Glenn Kent, James Thomson, and Edward Warner for their general guidance; Robert Komer and Philip Dadant for their careful reviews; Paul Davis, Robert Levine, Mark Lorell, Richard Nehring, David Shlapak, Mary Morris, and Nikola Schahgaldian for their assistance on many Central Command issues; Edison Cesar for his thoughts on Air Force deployments; Morton Berman, Thomas Kirkwood, William Mooz, Michael Rich, and William Stanley for their work on aircraft support; Benjamin Lambeth for his general expertise in tactical airpower; and Lt. Col. R. Fuller and the personnel of the 4449th Mobility Support Squadron for sharing their knowledge about bare base operations. Colonel H. Shinol, Lt. Col. B. Watts, and Lt. Col. R. Deturk provided many helpful comments, as did my action officer, Lt. Col. J. Klusman. Marilyn Yokota applied her research, artistic, and text-processing skills to this study. The author is of course responsible for any errors that may remain.

CONTENTS

FIGURES

I. INTRODUCTION

American interests in Southwest Asia have assumed almost the same level of importance as U.S. interests in Europe and the Far East.[1] Major U.S. interests are located in and around the Persian Gulf, bounded by Iran, Iraq, and the Arabian peninsula, and containing over 60 percent of the world's proven oil reserves. See Fig. 1 for a map of the area. Given the importance of oil to the economic health of both the United States and its allies, continued access to these vast reserves has emerged as a vital U.S. security concern.

Threats to halt or control this critical flow of oil come mainly from four sources: (1) politically motivated oil embargoes, as in 1973;[2] (2) attacks by hostile regional nations, such as South Yemen or Iraq; (3) internal instability caused by such things as factionalism, ideology, religion, or modernization; and (4) political coercion or direct attack by the Soviet Union.

The most demanding military problem is the possibility of a Soviet invasion of Iran aimed at securing control of the Persian Gulf oil fields. The Soviet objective in such a venture would be to deny the West access to this oil. The likelihood of a Soviet attack is impossible to determine, but the consequences are of such importance that it is imperative to improve the U.S. deterrent posture in Southwest Asia. The time period under consideration in this study is the mid-1980s to the early 1990s.

The United States Air Force would play a critical role in any possible conflict with the Soviet Union over the vital oil resources of the Persian Gulf area. Its importance would be magnified by the circumstances surrounding the U.S. strategic position in Southwest Asia. Although the region is at a vast distance from the Continental United States (CONUS), regional political sensitivities have forced the U.S. government to adopt a military strategy that, except for some naval units, does not rely upon peacetime-based forward deployed forces as in NATO and the Far East. To deter or meet Soviet aggression, U.S. strategy calls for the rapid insertion of effective fighting forces into the

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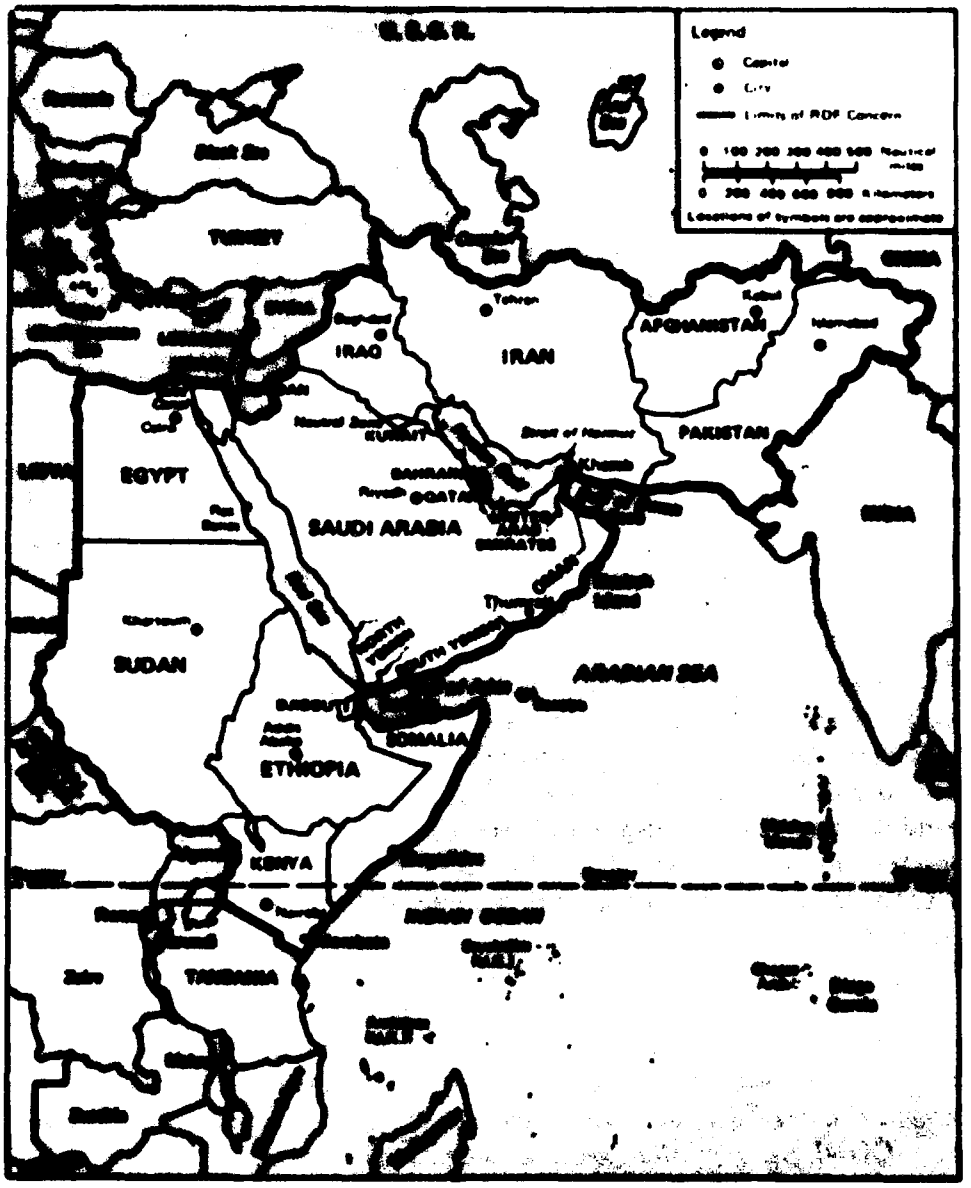
[1]As defined by the Congressional Budget Office, Southwest Asia includes the following countries: Pakistan, Afghanistan, Iran, Iraq, Saudi Arabia, Bahrain, Qatar, United Arab Emirates, Oman, South Yemen, North Yemen, Somalia, Kenya, Ethiopia, Sudan, and Egypt.

[2]Currently, the threat of an embargo appears quite small because of conservation, stockpiling, and OPEC's inability to set production quotas. However, given the instability of the region, the situation could change rapidly.



SOURCE: Adapted by Congressional Budget Office from U.S. Department of Defense Annual Report FY88

Fig. 1—Southwest Asia

area, relying upon such measures as political agreements with aligned regional states, host nation support, land-and-sea-based pre-positioned materials, sealift, airlift, and highly mobile, heavily armed combat forces. Air Force and naval air assets would undoubtedly form the first major signal of U.S. political commitment to defend the Persian Gulf and the first line of resistance to a Soviet attack.[3]

The Soviet Union enjoys major strategic advantages in the region, most of which stem from its location on the periphery of Southwest Asia, where it can apply its powerful land forces. A failure to deter or limit the penetration of Soviet forces into Iran in a drive to the Gulf would pose great danger to the continued flow of oil from the region. This could greatly damage the West's strategic position, because the economic health and military power of the United States and its allies in Europe and the Far East would be seriously jeopardized. For all these reasons, the speed and quality of an American response to Soviet aggression in this distant theater are critical for deterrence, placing a great demand on the intelligent exploitation of airpower.

The clear-cut nature of U.S. interests in Southwest Asia permits the use of a classical planning framework to examine the USAF role.[4] The development of specific military capabilities and supporting operational concepts must be coherently linked to U.S. national strategy and objectives. To do so, the planning process must be broken down into distinct hierarchical levels. Accordingly, Sec. II discusses American national objectives in Southwest Asia and the broad national strategy that the U.S. government has formulated to achieve these objectives. Section III examines the nature of the Soviet threat to these interests and provides some background on strategic considerations that were taken into account when the United States began developing a credible military strategy. Section IV discusses U.S. military strategy for possible contingencies, the forces being considered for operations in this demanding theater, and the programs initiated to support this strategy. Using this information, Sec. V attempts to identify what specific military capabilities the United States Air Force should enhance or develop to better support U.S. strategies and national objectives. Section VI lays out in some detail a concept of operations for one of these capabilities, strategic mobility for tactical aircraft.

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[3]Any increase in a threat to the region would probably find carrier battle groups steaming into position in the Indian Ocean. This has been a typical U.S. response to increases in tension. The deployment of land-based airpower, however, would be a much stronger sign of U.S. political commitment to defend its interests in the region. Further, the ranges involved make it unlikely that carriers could contribute much to attacking Soviet forces in northern Iran or providing aircover over the Gulf itself.

[4]See Kent, 1989, for a more detailed description of this classical planning framework.

II. U.S. OBJECTIVES AND NATIONAL STRATEGY IN SOUTHWEST ASIA

The development of vital American strategic objectives in Southwest Asia is a fairly recent phenomenon. Before World War II, the British played the dominant role in the region, the French, much to their dissatisfaction, played a secondary role, and the United States played a marginal role at best. After World War II the French departed precipitously, British power steadily decreased, and, as illustrated most dramatically by the Suez crisis of 1956, the United States achieved ascendancy. Although constantly plagued by irritating Soviet gambits for regional political influence, the United States remained the most powerful external actor in the area.

The Persian Gulf assumed greater importance in American defense thinking in the wake of the 1973 oil embargo and the attendant quadrupling of energy prices. The realization dawned that the United States and its allies had become dangerously dependent on this unstable region for oil. Congress sponsored a series of studies on the feasibility of defending or seizing oil fields,[1] and the Department of Defense initiated a series of studies examining U.S. and Soviet capabilities for power projection. These studies were the origin of most Southwest Asian programs in recent years.[2]

The increase in American attention paid to the region seems likely to continue. World oil reserves are estimated at 830 billion barrels. The Gulf states have some 60 percent or 500 billion barrels of these reserves, with Saudi Arabia alone holding some 207 billion barrels (24.9 percent of world reserves). The United States, in contrast, holds only 39 billion barrels in reserves (3.4 percent), the Soviet Union 72 billion barrels (6.6 percent), and Mexico 45 billion barrels (5.4 percent).[3]

To help protect this vast concentration of oil, the United States previously emphasized the role of regional powers under what was often termed the "Two Pillar" strategy. The United States hoped to maintain regional stability and deter Soviet expansionism by relying upon Saudi Arabia, the greatest economic power among the oil states, and Iran, which the U.S. government had aided both militarily and

[1]For the latest example, see Collins and Clyde, 1979.

[2]For an excellent analysis of the genesis of U.S. Southwest Asian programs, see Davis, 1982.

[3]See Nehring, 1982, p. 179.

economically since the end of World War II. Iran in particular came to occupy a central role in U.S. security policy for the region in the 1970s, because the oil price increases gave the Shah of Iran the funds he needed to purchase a vast array of American and other Western military equipment to defend Iran (and the Gulf) against external encroachment.

The Iranian Revolution and the Shah's departure in early 1979—an event whose repercussions are still being felt in American security planning—shattered this policy and heightened U.S. concern over the possible threat to Persian Gulf oil. In October 1979, President Carter announced plans to form a Rapid Deployment Force. Over the next two months, events in this "arc of instability," as Henry Kissinger has called it, combined to make the establishment of a credible expeditionary force seem even more important. In November 1979, "students" seized the American embassy in Teheran; almost concurrently Islamic fundamentalists attacked the Grand Mosque in Mecca, and only one month later, the Soviets invaded Afghanistan.

Intelligence analysis at the time suggested that the Soviet Union would soon become an oil-importing nation; with Iran wracked by revolution, internal strife, and virulent anti-Americanism, there appeared to be no very great military deterrent to a Soviet invasion of Iran aimed at securing control over the Gulf oil fields.[4] Although the United States could probably survive such a cutoff, its most important allies in Europe and the Far East could not. Accordingly, in January 1980 President Carter announced to Congress that "any attempt by an outside force to gain control of the Persian Gulf region will be repelled by any means necessary, including military force."

The primary U.S. objectives in Southwest Asia are to enable Western nations to enjoy secure access to the region's oil resources at a reasonable price. Establishing objectives is one thing. Developing a broad national strategy to achieve them is another.

At present, national U.S. strategy involves domestic, political, economic, and military elements. First, the United States has moved to limit its dependence on supplies of oil from this volatile region by increased buying from other oil exporting nations, such as Mexico and Nigeria. Second, the United States has attempted to decrease its dependency on all external sources through conservation, increased indigenous production, stockpiling, and the use of alternative energy technologies (fusion, solar, coal, gas, etc.). U.S. allies have been encouraged to do the same. Third, the United States has attempted to strengthen its political position in the region, as well as the position of

[4]For a useful overview of these events, see Johnson, 1982, pp. 8–14.

friendly regional states (simultaneously reducing Soviet opportunities for increasing their influence), through a policy of political, economic, and military assistance to some nations in the area. For example, the United States recently sold AWACS and F-15 aircraft to Saudi Arabia; it supplies Egypt with similar military assistance as well as food and economic aid. Fourth, the United States is attempting to ease its often strained relations with the Arab nations by working toward a settlement of the Arab-Israeli dispute. This would reduce the chances of a politically motivated oil embargo and also provide the Soviets with less opportunity for meddling.

Finally, to deter an overt Soviet attack, the United States has attempted to convince the Soviet Union that aggression aimed at securing control over the Gulf would elicit a major U.S. military response. It is hoped this response would inflict substantial losses on the Soviet invading forces and reduce the chances of a Soviet offensive that denied the West access to the region's oil supplies. Still, preventing the Soviets from attacking in the first place is a major pillar of U.S. national strategy. The United States has attempted to underscore its political commitment to the area and convince the Soviet Union that aggression in the Gulf region will present them not only with a determined American response, but also the possibility of escalation to wider conflict.

III. STRATEGIC CONSIDERATIONS IN SOUTHWEST ASIA

To give some teeth to this general approach, the United States had to develop a credible military strategy and supporting programs for deterring a Soviet attack. To do so, the United States examined, among other things, the nature of the Soviet threat and such other important strategic considerations as distances, basing for combat forces, and the harsh regional environment.

THE SOVIET THREAT

The United States would encounter great difficulties in conducting force projection operations in Southwest Asia, but so would the Soviets. Soviet forces located on the Iranian border have been given a lower priority in equipment and readiness than forces based in Eastern Europe or on the Chinese border. Of the approximately 20 divisions located on the Iranian border—two airborne, one armored, and the rest motorized rifle[1] —most are in a very low state of readiness. Mobilizing these forces for offensive action would require the Soviet Union to call up reserves and augment division transportation assets from the civilian economy.[2] This activity could not take place without providing the United States a strong degree of strategic warning. Future increases in the peacetime readiness of Soviet forces could reduce the amount of warning, but such actions would take a considerable period of time; by then, many programs designed to improve the U.S. deterrent stance in Southwest Asia may have reached fruition.

The heavy European emphasis of the Soviet Union's defense policy raises other difficulties for its abilities to conduct operations in Southwest Asia. Iran by itself is more than four times the size of France and Western Germany put together. Indeed, general distances in the Southwest Asian theater are very large; the distances from the Iranian border to the Gulf are on the order of 700 n mi. Opposition to a Soviet attack would be much less capable than in Europe, but the distances involved would place severe strains on the Soviet Union's limited logistical supply system, which is largely configured for

[1]See McNaugher, 1983, p. 20.

[2]A useful unclassified discussion of the Soviet threat to Southwest Asia is contained in Dunn, 1981, pp. 612–614.

supplying short-term blitzkrieg operations over the much shorter distances in the European theater.

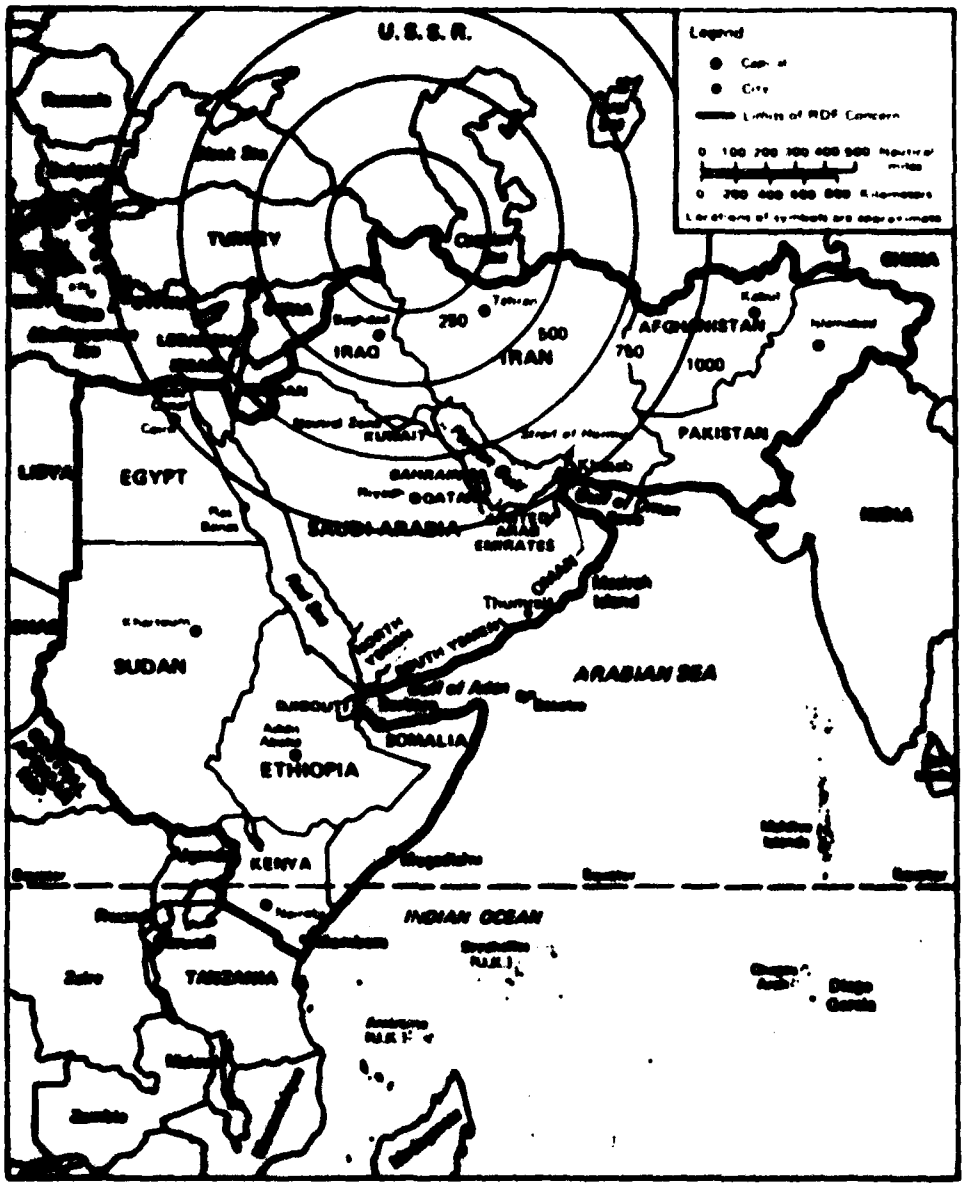
The distances from the Soviet border to the Gulf are also well beyond the operational radius of most of the Soviet Union's 800 tactical aircraft located on the border, and they currently possess only a minimal aerial refueling capability. Accordingly, should Soviet divisions push far enough south, the Soviets would be either operating without aircover or forced into seizing suitable Iranian bases and establishing forward operating sites in central and southern Iran (see Fig. 2).

Iran's extremely rugged terrain would also complicate Soviet planning. Iran features a central plain bordered by a massive salt desert 300 miles wide and 1100 miles long lying to the southeast of Tehran. To the north and south of the central plain lie two massive mountain ranges, covering about 50 percent of Iran's 636,000 square miles of land area. In the northern Elbruz Mountain range, vehicles traveling from the Caspian Sea to Tehran must in some sections climb from sea level to passes 12,000 ft high and then descend to 4,000 ft within the space of 50 miles.[3] The southern range—the Zagros Mountains—is similarly forbidding and would form a natural line of defence to prevent Soviet forces from reaching the Gulf should they push successfully through the northern ranges and cross the central plain. The only way to avoid going through the mountains in southern Iran would be for an offensive to push through Iraq after the capture of northern Iran. The advance of Soviet armored forces through these mountain ranges would be confined to a quite limited network of steep and narrow roads traversing many tunnels, bridges, and landslide areas. These chokepoints, of which over 300 have been identified, could be exploited to aid air or ground interdiction efforts.

A further problem involves the degree of local resistance that the Soviets could expect to encounter. Because of the war with Iraq, Iranian forces are currently not well deployed to deal with a Soviet attack in the north. However, any Soviet advances down Iran's western border region, which contains the most developed road network, would soon encounter dug-in Iranian forces.[4] The quality of these units could also be quite high. In the immediate wake of the Iranian Revolution, there were some fears that the new Iranian regime or its successor might destroy the military power so earnestly built up by the Shah. Purges of the officer corps, continuing internal and economic chaos, and problems in finding spare parts for Iran's complex

[3]Ibid., p. 618.

[4]For a useful overview of the war and current deployments, see Cordesman, 1983, pp. 36–43.



SOURCE: Adapted by Congressional Budget Office from U.S. Department of Defense Annual Report FY82

Fig. 2—Selected distances from the Trans-Caucasus/ Iranian border

military equipment seemed to justify this apprehension, particularly in view of Iraq's initial successes in its invasion across the Shatt-al-Arab in the fall of 1980. Three years of conflict, however, have seen Iraq's forces placed on the defensive; Iran's armed forces, now combat-tested, are perhaps a more effective fighting force than before the revolution. Iran is still experiencing problems in finding manpower and purchasing and maintaining equipment, but it now possesses a corps of veterans who might exact a heavy price on Soviet invading columns. Afghanistan guerillas have inflicted substantial destruction on Soviet forces and disrupted Soviet lines of communication with fairly primitive weaponry and limited coordination; Soviet difficulties in Iran could be considerably greater.[5]

A Soviet invasion of Iran would be an extremely difficult undertaking that would give any Soviet decisionmaker pause. This is not to say that the Soviet Union could not successfully carry out an invasion. The Soviets, after all, have roughly 20 divisions based on the periphery of the region; and local resistance would be much less capable, in terms of men and equipment, than in the case of a conflict in Europe. Furthermore, denial of oil to the West provides a strong motive. Nonetheless, the issues of distance, terrain, logistics, and potential local and U.S. resistance would create numerous uncertainties in the minds of Soviet decisionmakers.

DISTANCE

Besides the nature of the Soviet threat, U.S. strategists also had to consider certain aspects of the Southwest Asian theater that closely affected American military capabilities. The major considerations—distance, lack of basing, and regional environment—must form the background to any discussion of general military strategy.

When one senior officer was asked what his greatest problem was in preparing to conduct military operations in Southwest Asia, he stated: "Distance."[6] The shores of the Persian Gulf lie some 8,800 n mi from the CONUS by the most direct sea route (Savannah through the Mediterranean and Suez Canal to Damman), 12,000 n mi around the Cape of Good Hope if the Suez Canal is closed, and 6,200 n mi by the most direct air route (Charleston to Kuwait). Distances from the West Coast across the Pacific are equally formidable. A ship sailing from San Diego to the Gulf would on average have to travel some 11,500

[5]In Afghanistan, of course, the Soviets have undoubtedly learned a great deal about mountain warfare that they could put to use in Iran.

[6]Wilson, 1981.

n mi. These distances would pose enormous difficulties for the United States in deploying and supplying an adequate military force in the region and clearly shape the speed and character of the U.S. response.

If the Soviet Union were willing to expand the geographical area of the war, lengthy U.S. sea and air lines of communication would be vulnerable to attack, as would en-route bases. In the Falklands campaign, which was conducted at a similar distance from Britain as Southwest Asia is from the United States, one British official noted: "Soon after the fleet sailed, we became uncomfortably aware of the vulnerability of Ascension, which had no defenses. An Argentine frogman with a lit cigarette could have blown up the fuel depots on the island and destroyed the entire operation."[7]

The likelihood of a conflict over the Gulf extending to embrace attacks on U.S. shipping, aircraft, and bases in other world regions is, of course, difficult to determine. Such actions might provide the Soviets with some immediate tactical advantages in the course of a campaign for control of the Gulf, but Soviet installations and forces throughout the world would immediately become hostage to U.S. counterattacks. The prospect of coping with the powerful U.S. Navy and American land-based airpower might act as a sufficient deterrent to such action, because any theater advantage gained by the Soviet Union could turn into a major strategic defeat. Moreover, it would lead to escalation in the geography of conflict and perhaps in the weapons as well.

The other distance issue relates to the size of the theater itself. The distances involved would affect both airpower and ground forces. For example, conducting air strikes from the shores of the Gulf against the northern Iranian border would involve routes roughly 800 n mi long. The distances could create a situation where U.S. and allied aircraft would be operating at extreme ranges, particularly if the United States were unable to establish forward operating bases in, say, Iran or Turkey. As the Argentine Air Force demonstrated during the recent Falklands War, operating over long distances constrains combat maneuvering severely and may increase attrition. It also reduces sorties per day, raises fuel requirements, and decreases deliverable payloads or increases the required support from aerial tankers. Of course, the Soviet Union's aircraft could be encountering similar problems.

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[7]Interview with Sir Frank Cooper, former Permanent Under-Secretary, British Ministry of Defence.

BASING

Another primary factor the U.S. government considered in developing a military strategy to deter a Soviet attack on Southwest Asia was obtaining adequate basing for its forces. The fall of the Shah and the anti-American sentiment of the Khomeini regime in Iran removed in one stroke the strongest local U.S. ally in the region, one whose cooperation could be relied on to aid in countering Soviet aggression and regional strife.[8] As a result of the Iranian Revolution, the United States has found itself in the rather paradoxical situation of developing plans to defend Iran against a Soviet attack, but being unable to coordinate plans with Iran itself. And so far, no nation in the region has come forth to replace Iran as a linchpin of American security planning in the Gulf.

Obtaining the use of en-route basing along the shortest line of communication from the United States to Southwest Asia (East Coast through the Mediterranean) would probably not be difficult. A Soviet attack aimed at securing control over the oil reserves of the Persian Gulf would be a direct threat to the nations of NATO; the United States could therefore probably count upon the use of en-route bases in Britain, Germany, France, Italy, Spain, Portugal, and Greece, among others. Some observers have raised alarm over the conduct of NATO allies during the 1973 airlift to Israel, when most of these nations refused overflight rights to U.S. transports carrying supplies to Israel. However, these actions in 1973 were motivated by self interest—NATO nations, dependent on Persian Gulf oil, feared that supporting Israel would lead to an oil embargo against them with damaging economic consequences. A Soviet attack on Iran would directly threaten the national interests of U.S. NATO allies and would probably lead to much stronger European support of the United States. Further, the United States has hedged its strategic position by negotiating access agreements with Morocco for several airfields (provided these bases are not used to support Israel against any Arab nation).[9]

This left the issue of developing basing plans for forces in the Persian Gulf, and it is here that policy differs greatly from American policy in NATO and East Asia. In these other theaters, the United States has enjoyed sufficient political support from aligned nations to base forward-deployed forces in peacetime. These units would form the

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[8]Although the United States did not have any permanent military presence in Iran during the reign of the Shah (except for technical advisory teams), there was little doubt that the Shah would have cooperated extensively should the Soviets have begun threatening Iran's borders.

[9]See "Morocco in the Eye of the Sandstorm," *Africa Confidential*, 9 June 1980, pp. 1–4.

basis for initial resistance to aggression, after which CONUS-based forces, using pre-positioned equipment and lift assets, would be rushed to reinforce the theater-based units.

In Southwest Asia, however, obtaining peacetime basing for U.S. forces and pursuing a NATO/East Asia forward-deployed strategy was judged an unwise and, to date, a politically infeasible policy. Developing peacetime bases would cost a great deal and also commit a large fraction of U.S. ready forces to this theater. As the DOD 1981 *Annual Report* stated: "We cannot afford to tie down too many of our assets in one theater."[10] The possible instability of these modernizing regional states, as illustrated by the Iranian Revolution, demonstrated the potential dangers of laboriously developing bases and establishing forward-deployed forces. Oman is one of the strongest supporters of the United States in the region, largely because of the pro-Western orientation of Sultan Qaboos Ibn Said.[11] Yet Qaboos took power through a coup and has been engaged in continual fighting with Dhofari guerrillas; the political attitude of any successor is necessarily unclear.[12]

Perhaps most important, the presence of U.S. combat forces in the region could lead to severe foreign policy problems with nations in the Gulf. These nations are extremely averse to the presence of U.S. forces in peacetime, as witnessed by their consistent policy of permitting only limited military cooperation with the United States. U.S. friends in the region are extremely sensitive about being seen as "pawns" of the United States, perhaps an understandable attitude given the experiences of most of these nations at the hands of the Ottomans, British, and French during the 19th and 20th centuries. As one regional expert stated:

> In order to stay in power, all leaders in the area must constantly proclaim their independence from the superpowers. Nobody believes them, of course, but it's still a vital part of domestic politics. After all, *somebody* had to be cooperating with the imperial powers in previous years.[13]

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[10]*Department of Defense Annual Report, FY1981*, p. 118.

[11]Qaboos was educated at Sandhurst and has a great admiration for the British, the former (until 1971) guardians of the Gulf. Indeed, his armed forces are officered almost exclusively by the British.

[12]Qaboos has no children and hence no clear successor. For further information on Oman, as well as an interview with Qaboos, see Tasher, 1980, pp. 21-28.

[13]Author's interview with N. Schahgaldian, The Rand Corporation.

Providing U.S. forces with peacetime bases could strengthen the hand of opposition movements, such as Muslim fundamentalists, and lead to a destabilization of local governments, particularly in light of U.S. support for Israel. As one senior foreign advisor in Oman stated: "Peacetime bases? You will have to live without them." He went on to note that the presence of substantial U.S. forces in Oman during peacetime could severely damage the position of the Sultan, particularly if American personnel were involved in traffic accidents or other disputes with Omani nationals,[14] which might be arranged by a foe of the regime.

These difficulties seem to be part of the postwar historical trend that foreign nations are less and less willing to permit the peacetime basing of American combat forces; in 1968, for example, the Air Force enjoyed the use of some 60 overseas operating bases, but by 1977 this total had shrunk to around 27. This was of course in large part because of U.S. decisions to consolidate its foreign base posture, but it was also in part because of pressures from foreign nations. Regardless of the reasons for this contraction, many more bases are unlikely to be made available for U.S. forces, if indeed the United States would want, or could afford, to build them. The "price" of these installations has been escalating at a rapid rate, as foreign nations attempt to extract higher and higher political and economic concessions in exchange for the use of their territory.

These political considerations also played the major role in the evolution of the current U.S. basing policy for Southwest Asia. This policy, as stated by Secretary Brown in 1981 and reaffirmed by Secretary Weinberger in more recent years, is quite basic: "We seek no permanent bases in the region for naval units, ground troops, or air forces."[15] Instead, the United States has decided to emphasize the use of indigenous regional facilities (host nation support) in the event of a crisis. The Persian Gulf's industrial infrastructure, though certainly not as well developed as that of Europe or South Korea, improved greatly after the increase in oil prices created so much surplus capital for regional investment. Accordingly, the U.S. strategic position has benefited, and will continue to benefit, from the desire of most Persian Gulf nations to build up a modern industrial and economic base.

In addition, the United States has negotiated "contingency access agreements," whereby certain nations have agreed, time and circumstances permitting, to provide the United States with access to certain facilities in the event of an emergency. The United States is

[14]Author's interview with Sir A Ackland of the Omani Ministry of Information.

[15]*Department of Defense Annual Report, FY1982*, p. 33.

aiding in the development of these facilities in conjunction with these states. Further, the United States has taken advantage of its close ties with Britain and built up support facilities on the island of Diego Garcia, which is leased from the United Kingdom for joint use.

Diego Garcia is the only site where U.S. forces can be based in peacetime. It is some 2,250 n mi from the Straits of Hormuz and 3,200 n mi from the Iranian-Turkestan border, so it would be of limited utility for fighter aircraft operations, but very useful for long range combat aircraft such as the B-52s in SAC's Strategic Projection Force. It would also be a vital staging base, particularly because the ability to base forces on the island in peacetime permits greater preparation.[16] Some $237 million was allocated in FY82 and $58 million in FY83 to improve the facilities in addition to the $210 million already spent, a total of roughly half a billion dollars.[17] Currently, Diego Garcia is an anchorage for 17 chartered ships loaded with Army and Air Force supplies and pre-positioned equipment for a 12,000 man Marine Amphibious Brigade.

Developing arrangements for bases in the more immediate area has been more difficult.

Except for Iran, Turkey would probably be the best location for basing tactical aircraft to interdict Soviet columns invading northern Iran, and some upgrading is reportedly underway on at least three eastern Turkish airbases; but both the U.S. and Turkish governments have stressed that these initiatives are designed specifically to improve NATO's defense posture.[18] As Richard Perle testified before Congress in March 1983, these bases "will be used in a *strictly NATO context*."[19] Should a conflict over the Gulf extend to involve NATO, Turkey would undoubtedly, by treaty commitment, aid in operations. However, given Turkey's proximity to sizable Soviet forces, the chances of the Turkish government risking the wrath of the Soviets *strictly* for the sake of Iran and the Gulf would be questionable.

Saudi Arabia's vast oil reserves and economic power in the region make her an important political force, and her rapidly developing

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[16]U.S. access to this base is fairly secure, but some elements of the opposition Labour Party in Great Britain have begun to consider cancelling the lease agreement. For more information on the problems surrounding the Diego Garcia lease, see Larus, 1982, pp. 44-54. The Labour Party, which has a strong tradition of pacifism, was irritated over the use of Diego Garcia as a staging base for the Iranian hostage rescue mission and has also queried whether American nuclear weapons are stored on the island.

[17]See U.S. House of Representatives, Report No. 97-400, 11 December 1982, and *Military Construction Authorization Act, 1983*, Report No. 97-535.

[18]See *The Diplomatic Pulse*, 1 November 1982.

[19]*Hearings Before a Subcommittee of the Committee of Appropriations*, House of Representatives, FY 1984, Part 5, p. 9.

industrial infrastructure and military forces make her an important strategic asset. Saudi Arabia, however, has adopted a very ambiguous attitude toward close military cooperation with the United States. The Saudi government is staunchly anti-Communist and has sought to improve its defensive capabilities. It is spending billions of dollars to create several "military cities" (which are largely constructed by U.S. companies)[20] and has also recently procured or begun negotiating the procurement of such items from the United States as F-15 interceptors, F-5s, K-E3A tankers, C-130 airlifters, various C^3I facilities, AWACS aircraft, AIM-9L Sidewinders, AIM-7F Sparrows, and Maverick missiles.[21] There is also the possibility that the Saudis will purchase M-1 or Leopard II tanks and Bradley infantry fighting vehicles in the future. Nonetheless, the Saudi government has refused to consider negotiating contingency access agreements with the United States.[22]

Bahrain, an island nation located in the middle of the Persian Gulf, could also be useful, but political considerations have again rendered this option difficult.[23] Jordan has taken a similar position. Iraq, locked in combat with Iran, has typically proved hostile to the United States, though a Soviet attack could persuade the Iraqi government to aid Iran and the United States.

Israel could be of great assistance in the event of conflict, particularly in regard to providing POL, supplies, and maintenance equipment, because the Israelis operate many American aircraft and other military hardware.[24] In September 1981, a treaty promising "strategic cooperation" between the United States and Israel was signed, but it was abrogated after the Israeli annexation of the Golan Heights. By late 1983, the governments of Israel and the United States renegotiated a "strategic cooperation" agreement and have begun talks aimed at improving coordination, but there is no evidence linking this agreement to U.S. efforts in Southwest Asia.

In other countries the United States continues to negotiate "contingency access agreements" to use facilities with the consent of the owning nation in the event of possible conflict—for four bases in Oman (Khasab, Masirah, Seeb, and Thumrait), a base and airfield in Kenya (Mombasa), and two bases in Somalia (Berbera and Mogadishu—see

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[20]Some analysts have claimed that Saudi bases are actually "overbuilt" in order to serve as Central Command bases. See Johnson, 1983, p. 26.

[21]*Aviation Week & Space Technology*, 23 May 1983, pp. 48–49.

[22]For one Saudi perspective, see Mansur, 1981, pp. 36–41.

[23]The U.S. Navy maintains a six acre naval facility in the Al-Jufayr section of the island, but the 100 or so naval personnel on the island maintain a very low profile. See Watson, 1979, p. 2.

[24]For some biased but well-argued analysis on these points, see Rosen, 1982.

Fig. 3).[25] The United States has also pursued negotiations with the Egyptians over the use of Ras Banas, a former Russian air base located on the Red Sea. Although the Egyptians have generally proved cooperative, particularly in exchange for food, weaponry (such as F-16s), technical assistance (such as repairs for the Aswan Dam),[26] and cash[27] they have so far proved unwilling to sign a written agreement. Many elements in the U.S. government believe this not unusual considering internal sensitivities, but the lack of a written agreement has led to continual problems with Congress over the allocation of funding.[28] Negotiations between Egypt and the United States over who will pay for and carry out base development have encountered continual problems.[29] However, in late 1983, a Congressional panel recommended the approval of $49 million to improve facilities at this base.[30]

Out of all these "contingency access" bases, the ranges involved make only those in Oman of much use for supporting tactical air operations in Iran (such as F-111 strikes) or aircover missions over the Gulf. The remainder would be useful primarily as port facilities for the growing American Indian Ocean fleet and as rear area staging bases for aircover, air lift, and long range bomber operations (see Figs. 4 and 5).

Whether the United States could count on access to these and other facilities at a time of crisis in the region is difficult to determine. For all the sensitivities these nations have displayed over aligning themselves with the United States in peacetime, their attitudes in the event of Soviet aggression against Iran would probably be considerably different. Debates over imperialism and non-alignment would be bound to take a backseat when these nations were in direct danger. These sensitivities could lead to a delay in permitting the United States to insert forces, particularly in the event of ambiguous warning, but overt signs of a Soviet invasion of Iran would probably lead the Persian Gulf states to request American assistance; and even such a normally hostile power as Iraq, if threatened by direct or indirect attack by the Soviet Union, could decide to side with the United States. In the event of a Soviet attack, the governments of these nations would depend on the

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[25] *DoD Authorization for Appropriations for Fiscal Year 1983*, Part 6, Force Projection and Sea Power, p. 3764.

[26] The Soviets apparently installed defective turbine blades in the dam and these are continually cracking. See the *Los Angeles Times*, 10 April 1983.

[27] Egypt is the second largest recipient of U.S. foreign aid (next to Israel).

[28] *DoD Authorization for Appropriations for Fiscal Year 1983*, Part 6, Force Projection and Sea Power, pp. 3764–3765.

[29] Halloran, 1983b.

[30] "House Panel Approves Egyptian Base Funds," *Washington Post*, 19 November 1983.

SOURCE: DoD Authorization for Appropriations for Fiscal Year 1983, Part 6, Force Projection and Sea Power, pp. 3764–3765

Fig. 3—Military facilities in Southwest Asia

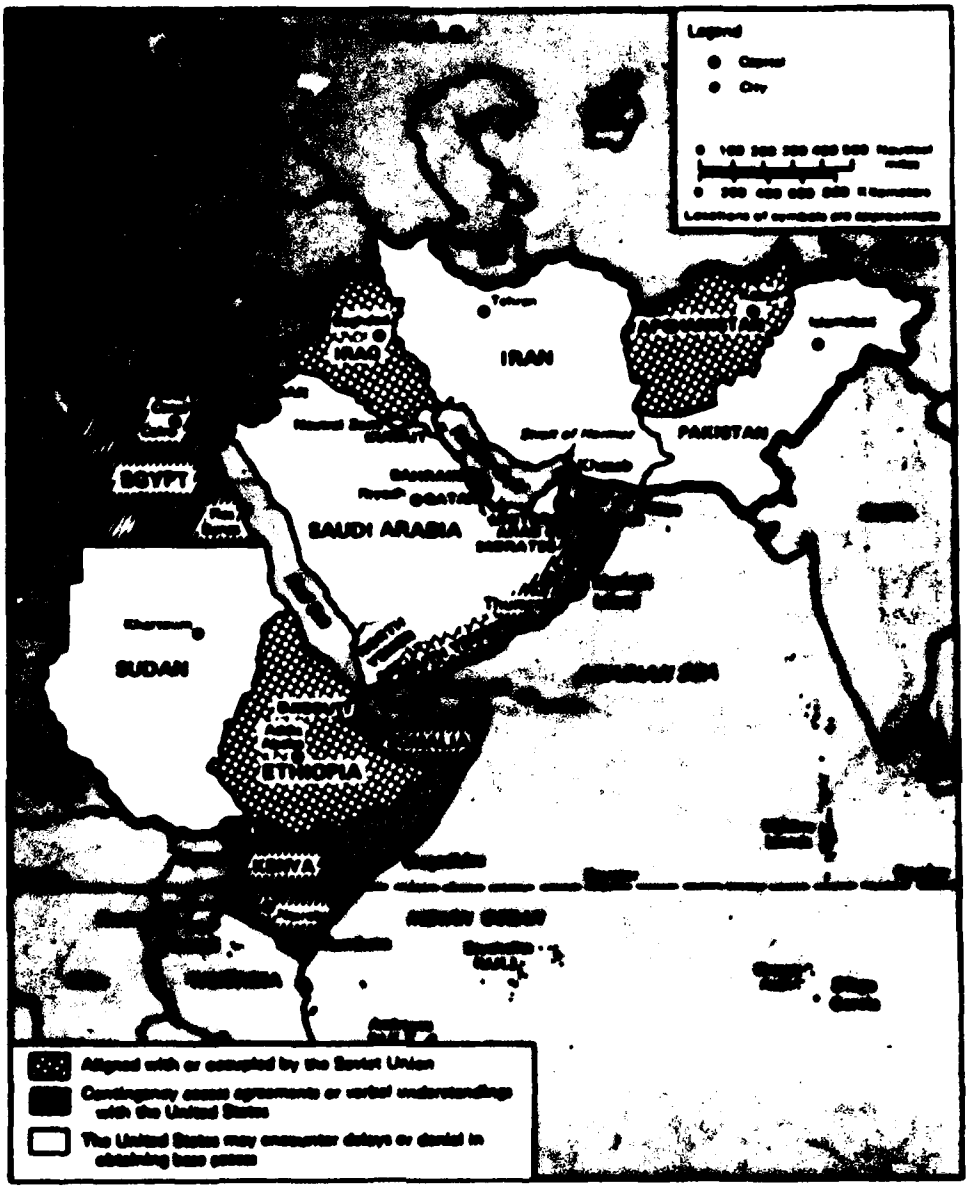
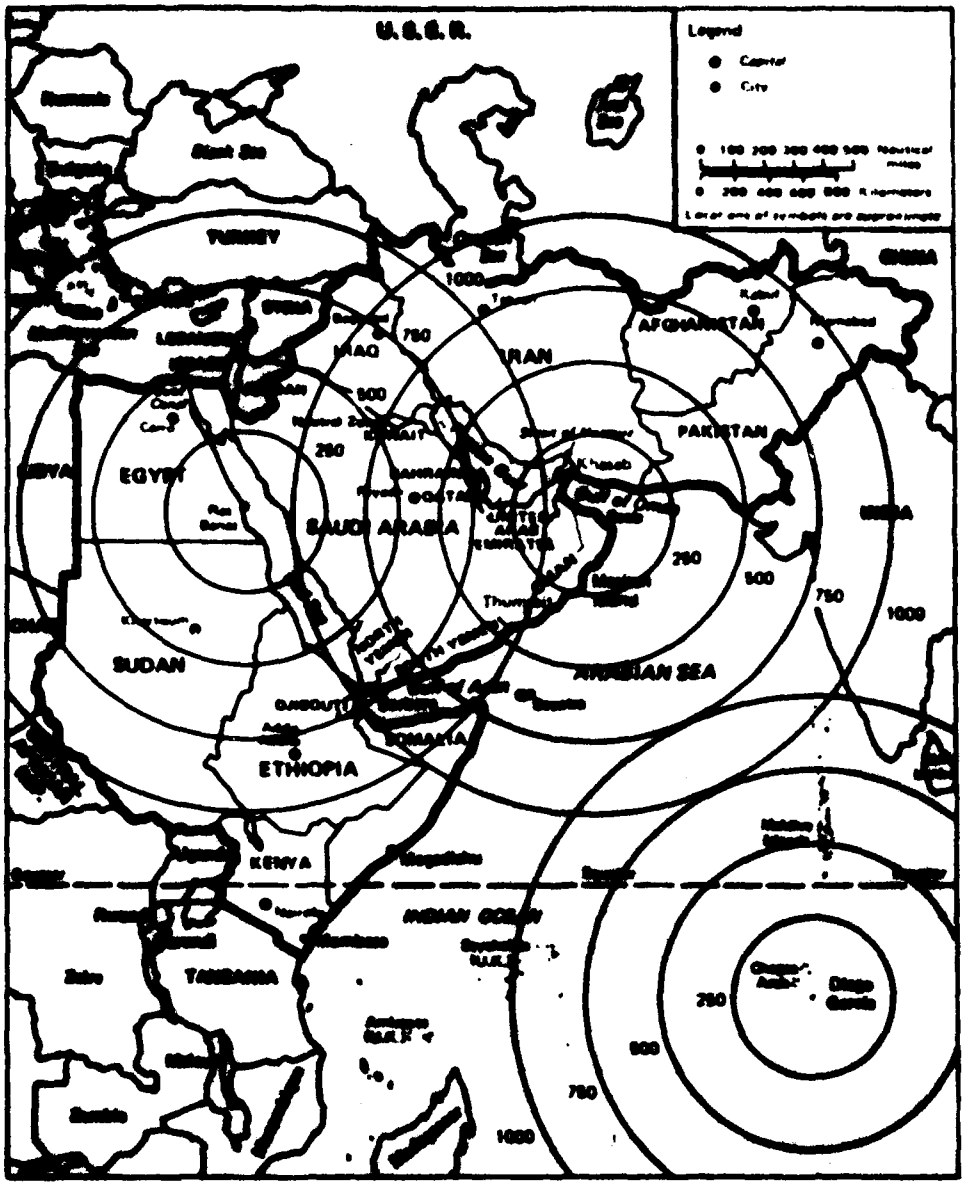


Fig. 4—Political alignments and base access in Southwest Asia



SOURCE: Adapted by Congressional Budget Office from U.S. Department of Defense Annual Report FY82

Fig. 5—Selected distances from facilities in Southwest Asia

United States and that would certainly ease the problem of securing access to these facilities. U.S. national and military strategy relies heavily on the timely insertion of deterrent combat forces; this in turn depends in part on the willingness of regional states to share U.S. perceptions of Soviet intentions. American military planning must therefore have great flexibility.

The nature of the facilities that the United States is negotiating over also has important implications for U.S. military strategy. At present, the Gulf nations closest to the Soviet border that would be most useful for basing combat forces (Saudi Arabia, Bahrain, Kuwait, Iraq, and Iran) also possess the most developed industrial infrastructure. These nations, however, are either against close cooperation with the United States or politically hostile. Oman, Egypt, Kenya, and Somalia are not only further from the probable scene of combat, but are also much poorer and accordingly, the facilities the United States is negotiating over are extremely deficient in support infrastructure (roads, railways, pipelines, water, etc.) taken for granted in Europe and South Korea.

This causes particular concern for the USAF, because the effectiveness of American airpower depends upon developed bases and massive infusions of ammunition, jet fuel, and other consumables. Ras Banas has two unimproved runways and no reliable source of water or electrical power; Khasab has a gravel strip; Masirah, though in the process of being upgraded, has a runway with limited POL and no ammunition storage facilities; Seeb, an international airport, has good runways but limited fuel storage and no ammunition storage facilities; Thumrait, a modern Omani tactical fighter base, is too small to support anything but the most modest level of air operations.[31]

To improve the situation, the U.S. government has moved to upgrade these facilities. Some $437 million has been allocated so far, with Oman identified to receive $224 million, Kenya $58 million, Somalia $54 million, and Egypt $91 million.[32] An additional $137 million was requested for developing the facilities in these four nations in the FY1984 budget.[33] Congress, however, has been generally reluctant to fund development in the region on the scale requested, because members of Congress are unwilling to spend such sums without seemingly more secure access agreements. For example, Congress deleted funds for the Ras Banas base improvement scheme for FY82, granted

[31]DoD Authorization for Appropriations for FY83, Part 6, Sea Power and Force Projection, p. 3764.

[32]*Annual Report to the Congress, FY1984*, p. 208.

[33]*House of Representatives Subcommittee of Committee of Appropriations, FY84, Part 5, Military Construction Committee*, p. 115.

only half of the requested $180 million in FY83, and allocated only $49 million for FY84.

In short, the United States has found itself with a vital interest in the area, but insufficient local political support, except in the case of distant Diego Garcia, to permit the peacetime basing of its forces. This in turn has led to the current basing policy whereby, as Secretary Weinberger has stated: "We are not creating any new *U.S.* bases, per se, in Southwest Asia. Rather, we are improving existing facilities that we might use in crises or for peacetime exercises and are arranging prompt access when needed."[34] Unfortunately, the somewhat tenuous nature of the basing access agreements has not encouraged enthusiastic Congressional support for the development of those few facilities in the region where the United States has negotiated "contingency access agreements," and the timely insertion of deterrent forces is still dependent upon gaining the agreement of regional nations. Such a situation is bound to place new demands on U.S. combat and mobility forces.

REGIONAL ENVIRONMENT

Southwest Asia is a large geographical region that features a varying and demanding environment. Some areas, such as the mountain regions in Iran, feature a climate similar to Europe, with very cold winters and fog and heavy cloud cover; the central Iranian plain around Tehran has a climate resembling southern California—the average high temperature during January, for example, is 45°F and some 96°F in July.[35] Cairo in Egypt features a similar temperature range. Such other areas as the Arabian Peninsula have very hot, arid climates that, according to one participant in the 1981 Bright Star exercises, "are unpleasant to live in, much less fight in." Poisonous insects and reptiles, disease,[36] lack of water, and extreme heat and variations in temperature are common to much of the region.[37] The heat in some areas could cause many problems, particularly for the efficiency of personnel, because sunstroke and heat exhaustion are common. For these reasons, the U.S. Army has stated that at least two weeks of living in such an environment are required for personnel to become acclimated.[38]

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[34]*Annual Report to the Congress, FY1983*, pp. III-107.

[35]Temperatures in the following discussions are drawn from *The National Geographic Atlas of the World*, National Geographic Society, Washington, D.C., 1981.

[36]In the 1958 landings in Lebanon, for example, over one-fifth of the 5,000 man force came down with illness in the first week.

[37]For a useful summary of the problems from an Air Force point of view, see Becher, 1982.

[38]See FM-90-3, *Desert Operations*.

The extreme heat makes it more difficult to perform maintenance work on unsheltered aircraft and other equipment, and one must wear gloves to touch metal in these temperatures without suffering severe burns. As one illustration of the problems caused by the temperature, during the 1980 Red Flag exercises in Nevada, men wearing standard-issue steel toed boots suffered severe blisters from the metal in their footwear. Tennis shoes proved to be more successful.[39] And the heat can also affect aircraft. For example, F-15s serving in the Far East became inoperational for a time because the sun warped the canopies, making a sealed fit impossible.[40] The Israeli experience in the 1967 War should also be kept in mind, for the Israeli Air Force found that heat damaged the fuel feed mechanism on its new Mirage fighters, requiring a rapid fix during combat.[41] Rapid cooling during the night—temperatures can fluctuate as much as 70°—can cause a great deal of stress on metal, plastic, and electronic components after the high daytime heat.

There is little potable water in the area. This must be supplied either by tankers or desalination plants and then delivered to fighting forces. The new planning factor for desert operations is 20 gallons per man per day (including that for equipment).[42] When the defense of the Persian Gulf assumed some urgency after the fall of the Shah, there was much fear, particularly in Congress, that supplying water would prove impossible. This outlook, however, seems unnecessarily pessimistic. In the first place, although the Gulf nations currently produce only sufficient potable water for their peacetime needs, a wartime situation could result in local water rationing, curtailments in irrigation use, and reduced supply to industry. Second, the Gulf nations are allocating large sums of money toward increasing their indigenous production of water. And third, the water supply problem has been alleviated by U.S. acquisition of portable water purification devices.[43]

Much of the area is covered in sand and subject to sandstorms. This raises difficulties for all forces—American, Soviet, and local—that will have to operate in the area. As one example of the problems

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[39]Becker, 1982, p. 23.

[40]See *Aviation Week & Space Technology*, 21 January 1983. Different materials were used to build new canopies.

[41]See Erdman, 1976, p. 39. The Israelis passed this information on to the Swiss in the hope of obtaining spare parts for their Mirages.

[42]Johnson, 1983, pp. 90–91.

[43]These devices, called Reverse Osmosis Water Purifiers (ROWPUs), utilize plastic membranes to desalinate salt water.

involved, many pocket calculators will become inoperable in a short time, because sand enters the spaces around the keys and jams them.[44] The Army discovered during the 1980 Bright Star exercise that sand particles pitted helicopter rotor blades, although this problem was alleviated to some extent by placing electrician's tape over the blades to protect them.[45] The Iranian hostage rescue team also experienced many problems with sand.

Sand could also damage such sensitive equipment as logistics computers and avionics intermediate shops. It will always find the weakest link in equipment; for example, a computer may be kept in an air-conditioned and dust free environment, but the sand may attack the generators sitting outside supplying power to the environment control equipment. A U.S. World War II manual instructed aircraft maintenance personnel that:

> Sand is the foremost foe of your equipment. Not only the sand in the terrain, but the dust found in suspension in the air. . . . There is the deadly scratching, gouging action of pebbles, and the terrific abrasive qualities of dust with the fine consistency of talcum powder. . . . The life of an airplane and its parts is unbelievably short once you let dust and sand get the upper hand.[46]

Air Force maintenance requirements would undoubtedly increase because of the sandy conditions. Jet engine replacement and repair would take place with increasing frequency, because modern turbofan engines are extremely sensitive to particle ingestion.[47] For example, during a test at Holloman Air Force Base in the mid-1970s, a C-5A ingested sand into its engines and, because of improper engine control settings, destroyed three of its powerplants (proper adjustments of the fuel-air mixture would have been able to prevent such damage). The sand may also reduce sortie rates. At Holloman, which has narrow runways, the departure of a single C-5A can shut down an entire runway after takeoff for four hours. The blowing sand generated by the jet blast covers the runway and increases the chances of sand ingestion for following aircraft; accordingly, the entire surface must be swept clean.[48] The Air Force had similar problems at times in Korea;

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[44]One solution to this problem is the use of membrane keyboards.

[45]See *Dod Authorization for Appropriations for FY82*, Senate Armed Services Committee, Part 4, Sea Power and Force Projection, p. 1724.

[46]Cited in Becher, 1982, p. 21.

[47]Reciprocating engine maintenance requirements also increase. During World War II, for example, USAF bombers and fighters operating from North Africa experienced many maintenance problems because of the sand and heat.

[48]The Israelis operate off some airfields surrounded by sand and one method they use to reduce blast-driven sand is to plant trees all around. This technique, however, would probably not aid Central Command.

one method used to reduce the amount of blast-driven airborne particle matter was to tow aircraft onto the flight line rather than taxi.[49]

There is no doubt that the Air Force can fight effectively in Southwest Asia. The Israelis have been using American aircraft with great success under climatic conditions similar to much of Southwest Asia, and Iran, Saudi Arabia, Egypt, and Jordan have procured and operated U.S. aircraft. Nonetheless, operations in the Southwest Asian theater could require many adjustments to the normal maintenance of aircraft.

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[49]The Air Force has had experience operating in dusty conditions in Korea. As F. Futrell states: "[In Korea] taxiing jets stirred up billowing clouds of dust, and, although maintenance units improved the dust problem by towing the jets to starting positions at the end of the runway, air-filter changes were frequently necessary." See Futrell, 1961, p. 172.

IV. U.S. MILITARY STRATEGY, FORCES, AND PROGRAMS

With these and other considerations in mind, the U.S. government developed a general military strategy and several supporting programs. The general military strategy is to insert sufficent forces in time to deter a Soviet attack. Although distance, logistics, and lack of forward deployed forces would make it difficult for the United States to match the size of Soviet forces on the region's perimeter, the deployment of small U.S. forces, such as a battalion of airborne troops or a few squadrons of interdiction aircraft (perhaps F-111s) could serve important strategic purposes. These actions would demonstrate U.S. commitment to the region, reassure local allies, and attempt to convince the Soviet Union that aggression will bring the superpowers into open military conflict for the first time since the Siberian intervention of 1919.

Should this attempt fail, the United States would try to gauge the scope of Soviet ambitions in Iran. A Soviet thrust aimed at seizing northern Iran could meet with U.S. acquiesence on the lines of the partitioning of Iran during World War II (and the similar agreement between the British and the Russians in 1907).

However, the United States may join Iranian defensive units in attempting to slow the Soviet advance through the northern areas. And the United States would certainly attempt to meet any further southward-bound Soviet offensives at the key passes in the Zagros mountains leading to the coast.

This may be termed a "lodgement strategy," because, as the Soviets prepare to battle their way through Iran's hostile terrain and opposing forces, the United States would attempt to establish lodgements of sufficient strength in Iran to deter a Soviet offensive. Should the Soviets attack, these lodgements would be used to stop them or push them back. Following the successful establishment of these lodgements, the United States would then attempt to carry out that most demanding military maneuver—reinforcing these outposts while parrying enemy thrusts.

To support this military strategy, the United States established a series of programs involving forces, mobility, and logistics support. On March 1, 1980, the headquarters of a new Rapid Deployment Joint Task Force (RDJTF) was set up at MacDill Air Force Base as a subordinate to the Readiness Command. In January 1983, this headquarters formally became a separate command known as the Central Command.

It has been charged with developing plans for dealing with contingencies in Southwest Asia and reports to the President through the Joint Chiefs of Staff.

The Central Command conducts its planning for Southwest Asian contingencies with elements from the following force "reservoir"; the actual force mix in the event of conflict would of course be determined at the direction of the President and the Joint Chiefs of Staff.[1]

AIR FORCE (Commanded during operations by Commander of Ninth Air Force, Shaw AFB, S.C., reports to CINCCENT)

1st Tactical Fighter Wing, Langley AFB, Va.	F-15s
27th Tactical Fighter Wing, Cannon AFB, N. Mex:	F-111s
347th Tactical Fighter Wing, Moody AFB, Ga.:	F-4s
354th Tactical Fighter Wing, Myrtle Beach AFB, S.C.:	A-10s
366th Tactical Fighter Wing, Mt. Home AFB, Utah:	F-111s
121st Tactical Fighter Wing (Air Nat. Guard), Rickenbacker AFB, Ohio.:	A-7s
150th Tactical Fighter Group (Air Nat. Guard), Kirkland AFB, N. Mex.:	A-7s
57th Air Division, Minot AFB, N.Dak:	B-52s
552nd AWACS Wing, Tinker AFB, OK.:	E-3As
Two tactical airlift wings:	C-130s

ARMY (Commanded during operations by Commander of 18th Airborne Corp, Fort Bragg, N.C., reports to CINCCENT)

82nd Airborne Division (air droppable)
101 Airborne Division (air assault)
24th Mechanized Division (mechanized), Fort Stewart, Ga.
6th Cavalry Brigade Air Combat (heliborne), Fort Hood, Tex.
194th Armored Brigade (armor), Fort Knox, Ky.
two Army Ranger Battalions
5th Special Forces Group
1 Corps Support Command

MARINES (Commanded during operations by Commander of I Marine Amphibious Force, Camp Pendleton, California)

One Marine Amphibious Force (one division, one wing) formed from selected elements of:

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[1]Listing of units drawn from General P. X. Kelley's testimony before Congress in Hearings before the Senate Committee on Armed Services, *DoD Authorization for Appropriations FY82*, pp. 1708-1709, and *Fact Sheet*, Public Affairs Office, HQ Rapid Deployment Joint Task Force, August 1982.

I Marine Amphibious Force, Camp Pendleton, Ca.
II Marine Amphibious Force, Camp Lejeune, N.C.
III Marine Amphibious Force, Okinawa.
7th Marine Amphibious Brigade, 29 Palms, Ca. (with equipment pre-positioned on ships at Diego Garcia).

NAVY

3 carrier battle groups
1 amphibious ready group
5 maritime patrol squadrons
18 near term pre-positioned ships (most based at Diego Garcia)

The Air Force contribution to this force represents a rather formidable array of power. Assuming typical numbers of aircraft for the various wings and squadrons, Tactical Air Command could contribute 72 F-15s, 72 F-4s, 72 A-10s, 48 A-7s,[2] and 180 F-111s;[3] and Strategic Air Command could contribute B-52s and tanker and reconnaissance aircraft. Except for the F-4s, none of the tactical aircraft assigned are multi-mission aircraft; the F-15s, for example, would be dedicated to air-superiority missions, and the F-111s, A-7s, and A-10s would carry out ground attack missions. Should half of the F-4s be assigned to assist the F-15s in providing aircover and the other half to assist ground attack efforts, 23 percent of the combat force would be dedicated to air superiority missions and the remaining 77 percent to ground attack missions.

At the end of 1982, plans were reportedly in progress to double the size of Central Command's 200–230 thousand man force with the addition of two more Army divisions, an additional Marine division, and five more Air Force tactical fighter wings.[4] U.S. military strategy, however, required some other supporting programs besides the designation of a reservoir of contingency forces. As noted earlier, the U.S. government has so far been unable to establish peacetime bases, except in the case of Diego Garcia, and logistics and mobility programs were vital elements.

The majority of the support logistics program was examined in the discussion of U.S. basing policy. In essence, the United States has

[2]National Guard wings typically possess only one squadron of tactical aircraft. Two National Guard wings are designated for planning purposes in the Central Command "force reservoir."

[3]CONUS-based F-111 wings usually have 90 aircraft per wing.

[4]See Halloran, 1982, p. 1.

encouraged states in the region to develop fuel storage tanks, roads, port facilities, water purification plants, and other support items that could be pressed into service in the event of an emergency. An actual emergency, of course, would require a high degree of improvisation. Sales of U.S. military equipment to selected regional states would also aid in supporting U.S. forces once they arrive in theater, because there would be increased commonality between regional and U.S. equipment. Further, the United States has been developing the facilities owned by nations willing to negotiate contingency access agreements as well as the facilities on Diego Garcia. And finally, to augment these in-theater programs, Congress has allocated some $37 million to the Navy and Marine Corps to develop mobile port and fuel discharge facilities that can be erected where needed. The Department of Defense has requested an additional $62.5 million for FY84 to more fully develop the latter program.[5]

Mobility programs also enjoyed emphasis. The U.S. Navy is in charge of the SL-7 program, which involves the conversion of eight 33-kt large container vessels to function as fast sealift ships for the transport of Army forces. When completed, the eight vessels together will be able to transport almost an entire mechanized division from CONUS in a single sortie, although additional trips would be required to bring in the division's combat support increment.[6] The Department of Defense has also placed supplies and equipment aboard eighteen chartered ships (known as Near Term Prepositioned Ships or NTPS), most of which are based at Diego Garcia, and lie approximately six days sailing from the Gulf.[7] Six of these vessels contain the combat vehicles and support gear for a 12,000 man Marine Amphibious Brigade (MAB) and plans at present call for tripling the amount of this equipment to support 3 MAB.[8] The remaining vessels at Diego Garcia contain support gear for the Army and Air Force as well as common-user water and Petroleum, Oil, and Lubricants (POL).[9]

To replace these chartered commercial vessels with more effective vessels that require less-developed port facilities and can be "spread-loaded" to reduce vulnerability, the United States has also begun building thirteen purpose-built Maritime Pre-positioning Ships (MPS) for a cost of some $1.7 billion. These are scheduled to be ready for basing at

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[5] *Annual Report to the Congress, FY1984*, p. 214-215.

[6] Without the combat support increment, the deployed division would be able to fight for only a few days.

[7] This is assuming an average speed of 15 kt.

[8] *Annual Report to the Congress, FY 1984*, pp. 200-201.

[9] Ibid.

Diego Garcia and other ports by 1986.[10] In addition, a program begun under the Carter administration to increase the readiness of the National Defense Reserve Fleet, which consists of mothballed dry cargo and tanker vessels, has been expanded. Currently, twenty-nine vessels can be brought into operation within five to ten days (as compared to months for the 167 other vessels in the reserve fleet)—the Navy hopes to increase the number of enhanced readiness ships to seventy-seven by 1988.[11]

Airlift programs have also received attention and funding. Part of this renewed emphasis was spurred by programs initiated in the Carter administration to improve the U.S. NATO-reinforcement posture, but the fall of the Shah greatly increased Congressional support for these efforts. One of the several airlift programs involved the stretching and modification of the C-141A *Starlifter* force into C-141Bs. This program, initiated in the late 1970s and completed in 1982, increased the floor-space available on these aircraft by some 30 percent. It also added aerial refueling receptacles to the C-141s for improved operational flexibility. In a similar force improvement program, the Air Force has also begun re-winging the C-5A *Galaxy* force to provide increased airframe life.

In another important program that was in many ways a direct response to the demands raised by possible Southwest Asian contingencies, the Air Force has increased the utilization rate of its long-range airlift fleet by procuring more spares and adding additional crews. In terms of new aircraft, the Air Force has begun the acquisition of 50 C-5Bs and 44 KC-10s, the latter being tanker-transports that can carry substantial amounts of cargo. The Air Force has also supported the acquisition of the C-17, an outsize-cargo capable airlifter that can carry out both inter- and intra-theater missions and is designed for operations from small austere fields.[12] And there has been extensive analysis, but limited funding, of enhancing the cargo-carrying capabilities of aircraft in the Civilian Reserve Air Fleet (CRAF) by strengthening floors and widening doors.[13] In general, the CRAF enhancement program has encountered limited success because airline companies are

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[10]See Morrison, 1983, p. 24B; and, for a more detailed discussion, Dicker, 1983, pp. 966–969.

[11]*Annual Report to the Congress, FY1984*, p. 214. For some additional information on U.S. sealift resources, see Manning and Granger, 1979, pp. 49–51; Kendall, 1971, pp. 211-227; Holloway, 1983, pp. 29–37. For long-term U.S. sealift capabilities, see Lewis, 1983.

[12]See *C-17: The Multi-purpose Airlifter*, McDonnell Douglas, 1982, for further information.

[13]In September 1983, a CRAF Enhancement Contract was awarded to Pan American to modify one B-747 with options for 18 additional aircraft.

reluctant to add fuel-consuming weight to their aircraft, but innovative financing schemes may improve the situation.[14]

The Army has also contributed to the mobility equation by looking at methods to maintain heavy firepower, yet reduce the weight and "cube" of some of its combat forces. The 9th Infantry Division was designated as a test bed division and has experimented with such weapons as TOW-equipped dune-buggies, lightweight armored vehicles,[15] and more capable attack helicopters.[16] And, in an apparent direct response to possible Southwest Asian contingencies, the Army Training and Doctrine Command (TRADOC) has begun to develop a blueprint for so-called "light divisions." In a concept paper, TRADOC noted: "There is a requirement for a smaller, more strategically responsive and flexible light infantry division organized to respond to a broader spectrum of combat operations and a wide array of contingencies."[17] The proposed divisions, of which there may be as many as five, could fit all their equipment into C-141 or C-130 transports, thus reducing the amount of outsize-capable airlifters required for transport in the early days of a deployment.[18]

The services have also taken steps to ease problems caused by the regional environment. The Army has procured new desert camouflage uniforms and begun intensive training in the western United States to reexamine aspects of fighting in deserts and mountains. All three services have also participated with regional nations in the Bright Star exercises. These regional deployment exercises took place in 1981, 1982, and 1983; they involved the landing of Marine and Army troops, the deployment of tactical aircraft (F-4s, F-16s, and A-10s), and exercises of the Strategic Projection Force. These exercises have proven invaluable in exposing problem areas and familiarizing U.S. forces with the environmental and tactical conditions of the region.

Most of these programs should be completed in the late 1980s, and taking them into account reveals the following rough estimate concerning U.S. capabilities for the insertion of effective combat forces. Satellite warning of Soviet troops gathering on Iran's borders would cause the United States to increase U.S. naval presence in the Indian Ocean.

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[14]Most of these financing schemes involve leverage-leasing, which can confer tax advantages and hence increase airline company interest, because leasing is becoming an accepted practice in the passenger business. For more information on CRAF-related leverage leasing, see Stephenson, 1982.

[15]See Fitzmorris, 1979, pp. 9–11.

[16]See Everett-Heath, 1982, pp. 321–329.

[17]See Wilson, 1982, p. 2.

[18]See also *An Assessment of United States Army High Technology Test Bed*, Office of the Under Secretary of Defense, Washington, D.C., February 1982.

Possibly three carrier battle groups and one surface action group would be on hand to underscore U.S. commitment to the region. The United States would probably also attempt to insert some AWACS aircraft over the Gulf. These would be vital for augmenting air defense capabilities and the limited command and control facilities in the region. They have the added advantage of being perceived primarily as a defensive weapon system.

If it was judged that a Soviet move was inevitable and the United States wished to further enhance deterrence, the President would be faced with the difficult decision of inserting U.S. land and air units in the area to complement the naval task forces. If he chose to deploy forces, the first units to arrive would probably be tactical air wings, based possibly in Turkey, Iran, Saudi Arabia, Egypt, or Oman, plus perhaps some B-52s operating out of Diego Garcia or Egypt. Concurrently, elements of the 82nd Airborne Division (one battalion is held on 24 hours notice) or possibly one of the new light divisions could be inserted by airlift into one of the Gulf states or, more preferably, into Iran itself. Within six days of the order to deploy, the fleet of pre-positioned ships at Diego Garcia could arrive in the Gulf and MAC or CRAF aircraft would carry the 45,000 Marines to "marry up" with the equipment pre-positioned on these ships.[19] Within roughly two weeks, a mechanized division (without combat support), nearly all carried by the eight SL-7 fast sealift ships from the East Coast,[20] could begin arriving in the Gulf (seven days longer if Suez is closed).[21] And airlift, having carried in TACAIR's equipment in the same period, would begin devoting more of its efforts to lifting in the remainder of the 82nd and 101st (or additional light divisions), their combat support elements, and critically needed supplies. Some 30–40 days after the decision to move, more divisions would begin arriving by sealift, as would massive infusions of ammunition, POL, water, and other supplies.[22]

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[19]Still, it would take some two days for the "marrying up" to take place.

[20]The East Coast's ports are closest to the region, assuming of course that the Suez Canal is open.

[21]Given an average speed of 27 kt (the ships can do 33 kt, but according to Congressional testimony this speed is unlikely because of increased fuel consumption) and assuming that these ships would have already been loaded during the warning phase. According to Congressional testimony, loading these vessels requires at least two to three days.

[22]This is assuming a speed of 15 kt for the convoys, which would sail from CONUS through the Mediterranean and Suez, and loading of the vessels prior to the deployment decision. Actual time may be delayed because of: (1) problems in mobilizing the National Defense Reserve Fleet; (2) closure of the Suez Canal or convoy bottlenecks at the Canal; and (3) difficulties in loading the vessels. Domestic mobilization has until recently received little attention until grave deficiencies were revealed in the 1976 NIFTY

The effectiveness of this military strategy would depend largely on the time the President made his decision to deploy combat forces. This decision would hinge on such factors as assessments of Soviet intentions, the level of Soviet mobilization, the situation in other theaters, and the willingness of regional states to allow U.S. forces to enter their territory. None of these can be predicted, and a deployment decision could be delayed. Regardless, the speed at which the United States could insert forces would be critical.

NUGGET and REX exercises. According to the OSD report, *An Evaluation Report of Mobilization and Deployment Capability Based on Exercise NIFTY NUGGET 78 and REX 78* (1980), the United States had poorly coordinated mobilization procedures and great difficulty in loading ammunition and other supplies on ships. As a result, a new Joint Deployment Agency was set up to coordinate these procedures better.

V. THE AIR FORCE'S ROLE IN SUPPORTING U.S. STRATEGY

U.S. military strategy places great demands upon U.S. forces. It also places a great deal of emphasis on the role of airpower. Simply put, airpower could deliver firepower and combat forces *rapidly* to this distant region. For example, should the Soviets attack Iran, and the President chose to resist their offensive, B-52s in the CONUS supported by in-flight refueling could begin delivering ordnance against Soviet forces in northern Iran within 14 hours, even more rapidly if the B-52s operated out of Diego Garcia. Within the same period of time, U.S. tactical air assets could begin arriving, and air transports could begin delivering combat ready troops to the theater. Given some increase in readiness in the United States, this could all be done within 24 hours of the order to deploy.

Deploying aircraft to the region would provide a strong signal to the Soviets early in the campaign that the United States was serious about defending its interests in the region and might promote second thoughts in the Kremlin about continuing the venture, with its attendant risk of escalation. Should the Soviets be undeterred, airpower could be used to delay their advance while the United States set up lodgements further south. This section attempts to illustrate the relationship of Air Force missions to U.S. military strategy in Southwest Asian operations.

The Air Force would have five primary missions during a conflict in the Gulf:

- air superiority
- reconnaissance
- interdiction
- close air support
- airlift

Each mission would play a vital supporting role in U.S. military strategy, which in turn would help enhance the U.S. deterrent posture. Providing air superiority where needed would be a primary mission of the Air Force throughout the course of the conflict, particularly in the crucial initial stages of deployment when arriving forces would be concentrated on vulnerable air and sea transports and in a few reception areas. Currently, the Soviet air threat to transports in and around the

Gulf is necessarily limited to those Soviet aircraft with sufficient range to hit targets from bases near the Caspian Sea (such as Badgers, Blinders, and Backfires). Future Soviet aircraft, however, may enjoy much greater combat radii. And, as the Soviets become more deeply involved in Afghanistan, they may set up airbases in southern Afghanistan, which, although difficult to support logistically, could place more of their aircraft within range of Gulf targets. The Soviets could deploy aircraft into such aligned regional states as Ethiopia and South Yemen, although these bases would be tempting targets for carrier-based airpower. Or, in the course of their invasion, the Soviets could attempt to capture forward airbases in Iran or Iraq (by paratroopers or airborne divisions) to base their aircraft.

The interceptors and surface-to-air missile batteries possessed by regional nations could certainly make an important contribution toward reducing the air threat in and around the Gulf. Indeed, nations on the Gulf are currently spending billions of dollars to improve their air defense networks. Still, the effectiveness of these local forces must be questioned; they lack experience in combat, and U.S. fighters would still have to protect both transports and key reception facilities. Aircraft carriers could certainly provide a limited amount of air cover for arriving forces, but they will probably not go into constricted Gulf waters. Carrier-based fighters have insufficient range to cover the Gulf effectively from battle group positions in the Indian Ocean; and in any case, these aircraft might be too preoccupied with the defense of the carriers themselves to contribute substantially.[1]

Without at least local air superiority, the chances of successfully carrying out a grand scale amphibious or airborne operation in Southwest Asia would be decreased.[2] The Japanese experience at Guadalcanal, when they lost an entire division loaded on transports to U.S. airpower, is only one example of the vulnerability of transports to air attack. Thus the air superiority mission is linked directly to U.S. military strategy and the missions of the other services. Using the forces in the Central Command reservoir and appropriate basing in the Gulf, if the 72 F-15s and half of the 72 F-4s were assigned to air superiority

[1]Additionally, carriers may have trouble maintaining high sortie generation rates. Each carrier has to support up to nine different types of highly complex aircraft simultaneously and space constraints limit repair facilities. Because of these problems, carrier sortie rates typically degrade over time. See Lippiatt, 1982.

[2]The British landing on the Falklands is the only amphibious operation carried out since World War II without air superiority over the beachhead. Losses were not a critical problem but could have proven disastrous had the Argentinians fused their bombs correctly or possessed more standoff "smart" munitions. Another example of an amphibious operation carried out without air superiority includes Norway in 1940, which resulted in heavy losses for the British.

missions, the Air Force could generate almost 175 air superiority sorties per day (assuming an 80 percent operationally ready rate and two sorties per aircraft each day).[3] Accordingly, approximately seven aircraft could be launched each hour and, assuming an average sortie length of two hours, 14 highly capable interceptors could be airborne at all times. If these aircraft were assigned to form a protective buffer across the Persian Gulf, there would be roughly one airborne interceptor for every 35 miles of frontage.[4]

Air power would also be needed for providing rapid reconnaissance of the area before and after the initiation of hostilities. Although improvements in satellite reconnaissance have somewhat decreased the need for aircraft-based sensors, aerial reconnaissance would still be required to provide all branches of the U.S. government with information. AWACS aircraft, RF-4s, U-2s, SR-71s and possibly unmanned drones would absorb most of the burden for this mission.

By mounting a determined interdiction campaign, airpower could provide a means to slow or even stop a Soviet advance. B-52s could begin interdiction operations against Soviet maneuver units and key lines of communication almost immediately; and tactical aircraft, after deployment in the theater, could also contribute heavy firepower. As many have observed, Iran's narrow mountain passes, bridges, tunnels, and poor roads are well suited to interdiction operations.[5]

With the advent of new engagement systems, cluster munitions, gun pods, and other anti-vehicle weapons, airpower could prove quite effective in attacking Soviet mechanized columns. Over 20 Soviet divisions are in place on the borders of Iran, each of them equipped with thousands of vehicles. These tens of thousands of vehicles would provide an immensely lucrative target as they funnelled through the passes. Damaging and slowing the Soviet forces at night would prove more difficult, because the only aircraft in the U.S. Air Force tactical inventory at present that can attack effectively at night is the F-111 (although the Navy's A-6s enjoy similar capabilities), but the Air Force is implementing serious measures to provide more of its forces with the

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[3]Calculated using the following formula:

(OR × # of PAA) × SPA = total number of sorties per day.

Where: OR = Operationally Ready Rate
# of PAA = Number of Primary Assigned Aircraft
SPA = Sorties Per Aircraft (per day)

[4]The Persian Gulf is roughly 500 miles long. However, F-15s and F-4s will usually operate in pairs. Further, the Air Force would probably keep only a few interceptors airborne and the remainder on ground alert and rely on the AWACS aircraft to detect intruders.

[5]See Epstein, 1981, pp. 126-156, for some discussion of these points.

ability to conduct operations 24 hours a day. The purpose of the interdiction mission would be to damage and delay Soviet forces as the United States establishes lodgements further south.

Using the tactical ground attack aircraft in the Central Command force "reservoir" and assuming appropriate basing provide some idea of current U.S. interdiction capabilities. Assuming an 80 percent operationally ready rate for all aircraft, two sorties per day for the A-7s and F-4s, one sortie per day for the F-111s, and appropriate munitions such as GBU-15 modular guided glide bombs for tactical aircraft;[6] the force could deliver 845 GBU-15s and 571 Rockeye cluster bombs against selected targets each day.[7] The GBU-15s would prove most effective against such high-value targets as bridges, tunnels, and landslide areas. In addition, B-52s assigned to conventional missions in the theater could also contribute heavy firepower. Actual numbers and types of weapons delivered, of course, could vary greatly depending on basing, munitions availability,[8] and the level of Soviet resistance. For example, delivering munitions in northern Iran could prove quite costly, because the Soviets would be able to meet such attacks with their border-based interceptors and they would undoubtedly have strong surface-to-air defenses with their ground units.

If interdiction strikes and local resistance proved unable to contain the Soviet advance, eventually Soviet maneuver groups would come in contact with U.S. ground forces emplaced in lodgements further south. In this event, the Air Force, in conjunction with the Marines and Navy, would conduct close-air support missions to further damage Soviet forces and prevent local breakthroughs. Close air support could also prove useful in supporting Iran's ground forces should that country agree in the face of Soviet aggression to coordinate its defense efforts with the United States.

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[6]This is assuming nominal weapons loading of 4 GBU-15s per F-111, 2 GBU-15s per A-7, 2 GBU-15s per F-4. The GBU-15 is a television-guided cruciform wing glide bomb that carries a 2,000 lb warhead. It can be launched from both low and high altitudes and its high accuracy would make it very effective against bridges, tunnels, and other point targets.

[7]Calculations for number of weapons delivered derived from the following equation:

# of A/C	×	OR rate	×	Sorties per day	×	# of weapons carried	=	# of weapons delivered per day
48 *A-7*	×	.8	×	2	×	2 GBU-15s	=	154
36 *F4*	×	.8	×	2	×	2 GBU-15s	=	115
180 *F-111*	×	.8	×	1	×	4 GBU-15s	=	576

[8]"Smart" weapons like the GBU-15 are expensive to procure and difficult to produce rapidly. Accordingly, the Air Force may be forced to use iron bombs after a short time.

Finally, airlift would provide the United States with the means to insert combat ready forces and their critical supplies into the region. Airlift would also permit the rapid movement of supplies and material within the theater. This would be particularly important in Southwest Asia given the region's size and limited transport network. The purpose of the airlift mission would be to insert and supply a defensive force that is able to stop or at least greatly delay a Soviet drive to the Gulf.

Some idea of present U.S. inter-theater airlift capabilities can be gained from the following data. Assuming a route from Dover AFB to Dhahran using Lajes and Cairo West as refueling stops, Military Airlift Command's current force of primary assigned C-5As and C-141Bs could make 27 and 88 deliveries per day respectively.[9] Accordingly, the C-5As (assuming an average load of 68.9 tons) could deliver 1,860 tons of cargo per day, and the C-141Bs (assuming an average load of 27.5 tons) could deliver 2,420 tons per day from CONUS to Dhahran.[10] Philip Dadant, using a Rand-developed computer model and similar assumptions, has estimated that MAC's force could deliver a mechanized division from the CONUS within 12 days; a mechanized division plus its Combat Support Increment would take some 23.5 days.[11] As additional C-5s and possibly C-17s enter the airlift force during the 1980s and 1990s, U.S. airlift capability will increase proportionately. Further, KC-10s can also carry cargo, while long range aircraft from

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[9]These figures were derived from the following airlift formula:

$2T/S + L = H$

$UtR/H = M$

$M \times PAA =$ deliveries per day

Where: T = trip distance (6,500 n mi)
S = cruising speed (455 kt for C-5As and 440 kt for C-141Bs)
L = # of legs × 25 minutes (to allow for takeoff and landing)
H = flying hours per mission
UtR = utilization rate (12.5 hours)
M = # of missions per day
PAA = Primary Assigned Aircraft (65 C-5s and 220 C-141Bs—actual numbers of C-5s and C-141s are higher, but some would be assigned to other missions).

[10]Sorties per day × average tonnage per sortie = tonnage delivered per day. These calculations are estimates only, for much depends on the "cube" of the material to be transported, the percentage of MAC's force assigned to the mission, and the availability of fuel and en-route bases. For more detailed planning factors, see *Airlift Planning Factors*, AFR 76-2, HQ U.S. Air Force, Washington, D.C., 1982.

[11]Tonnage delivery calculations are useful for rough estimates of capabilities, but Dadant uses the floor-space as the measure in his calculations, which offers more accurate results than either tonnage or cube measures. See Dadant, 1984.

CRAF would also aid matters, particularly in the transport of personnel. The procurement of C-17s would also aid in the demanding intra-theater airlift mission, which at present would be carried out by the C-130 force.

The Air Force's five main missions—air superiority, reconnaissance, interdiction, close-air support, and airlift—support each other and the missions of the other services. For example, to deploy fighters and long range bombers into the region would require the extensive use of the transport force to bring in adequate logistics support and possibly bare basing equipment. The more airlift sorties required for this, the less that could be devoted to lifting in U.S. ground forces.

In the same way, the interdiction mission would be interdependent with the air superiority and reconnaissance missions as well as the general missions of the Army and Marines. For example, conducting interdiction operations in northern Iran requires that pressure be maintained against the key choke points through which the Soviets would move, because otherwise bridges, roads, and tunnels could be repaired.[12] To maintain such pressure in the face of heavy Soviet air cover would require that ground attack aircraft be given fighter protection. Further, reconnaissance work would be vital to the success of any interdiction campaign so that the most effective use of tactical air assets could be made. The purpose of the interdiction mission would be directly related to those of the Army and Marines; the Air Force would want to slow the Soviets sufficiently that the United States could deploy adequate ground forces in time to stop the Soviet drive to the Gulf.

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[12] For a most interesting analysis of the historical effectiveness of interdiction campaigns, see Dews and Kozaczka, 1982.

VI. CAPABILITIES AND CONCEPTS OF OPERATIONS

The issues of distance, basing, and environment have combined to create a difficult and demanding problem. U.S. military strategy and supporting programs have been designed to alleviate the situation, but there must still be some new initiatives in identifying and developing Air Force capabilities and concepts of operations that would best support U.S. strategies and political objectives.

As the preceding has illustrated, the U.S. Air Force plays a major role in supplying both speed and effectiveness to the U.S. military response, particularly in the crucial initial stages of a crisis. Accordingly, the USAF should accelerate its efforts in enhancing at least these three capabilities:

- increasing the capabilities of long range combat aircraft to apply conventional firepower for interdiction purposes.
- increasing the capabilities of airlift forces to aid the deployment of tactical air assets and ground forces.
- improving the strategic mobility of tactical aircraft—that is, the capability to begin operations out of bases in the area with a minimal amount of pre-positioned support.

Each of these capabilities would directly support U.S. military strategy. Using long range combat aircraft to interdict Soviet maneuver units could help slow the Soviet advance, within hours of the order to attack, and with a reduced need for forward bases. Improving the capabilities of U.S. airlift forces would enable the United States to establish lodgements more rapidly. The Air Force's has been committed to the use of long range combat aircraft for conventional missions; the need for improvements in the U.S. airlift capability has been widely recognized, and Congress has allocated substantial funds to increase the size and capabilities of the airlift fleet.

Improving the strategic mobility of tactical air, however, has received far less attention. The political circumstances surrounding the U.S. basing posture in Southwest Asia, combined with the critical need for tactical airpower early in the conflict, make it a vital Air Force concern to develop enhanced strategic mobility for tactical airwings—that is, the capability to begin operations *rapidly* out of the

often austere bases in Southwest Asia. Such a capability could enhance the U.S. deterrent posture by permitting the more rapid initiation of combat sorties and facilitate the re-deployment of U.S. tactical aircraft within the theater or to another theater altogether. For example, should a deterrent force of tactical aircraft be sent to Egypt or Oman before a Soviet attack, a Soviet offensive might require that these same aircraft re-deploy to Iran or other nations to get within closer range.

STRATEGIC MOBILITY FOR TACTICAL AIRCRAFT

With the advent of a jet-powered tactical air fleet after World War II, one of the prime attributes of the USAF tactical fighter force—strategic mobility—diminished appreciably. Current tactical aircraft are certainly far more capable than their predecessors, and the adoption of aerial refueling has made it possible for tactical aircraft to fly quickly to any area in the world. However, the increasing fuel, ammunition, and maintenance requirements have rendered such an operation difficult in any region where the United States does not enjoy either the peacetime use of bases or the ability to pre-position large stocks of support material.

It would be useful to understand the amount of material currently needed to support a wing of F-15s and its personnel at a bare base—a site possessing simply an adequate runway and a source of potable water. The wing would require approximately 1,080 tons of basic maintenance equipment (some 39 C-141B sorties),[1] an Avionics Intermediate Shop (AIS) to repair electronic equipment (three C-141B sorties), some 500 tons of communications equipment (16 C-141B sorties), and 150 tons of civil engineering equipment (five C-141B sorties). The Harvest Bare base material, which supplies personnel and aircraft support structures as well as sufficient electrical power generation equipment and water supply equipment, would weigh 1,234 tons (45 C-141B sorties).[2] In total, the F-15 wing would require 108 C-141B sorties for the transport of equipment, while setting up of this quantity of equipment would require some 60 days.[3] The F-15 wing would also require

[1]Tonnage derived from *Final Report on the Coronet Eagle F-15A/B Deployment*, Langley: TAC HQ, 1981. This deployment exercise involved the deployment of 18 F-15s to Europe—each F-15 required 15 tons of support gear. As numbers of deploying aircraft increase, support equipment tonnage per aircraft decrease somewhat.

[2]Equipment tonnage listings derived from data supplied by the 4449th Mobility Support Squadron at Holloman AFB.

[3]This is the usual planning factor for setting up bases at austere or bare sites, according to the 4449th Mobility Support Squadron. Squadron bases require 20 days for set up, wings 60 days.

349,600 gallons of fuel per day,[4] which, if airlifted in, would require 43 C-141B sorties. And sufficient supplies of air-to-air munitions, which are much lighter than ground attack munitions, would take up about three C-141B sorties per day.[5] Further, logistics would have to supply sufficient food and water to support the wing's 2,250 personnel. Obviously, requirements for some equipment—such as communications gear, civil engineering equipment, aircraft hangars, and personnel shelters—could be much lower depending on the nature of the base; but in any case, U.S. aircraft currently require a substantial amount of material for combat operations.

Perhaps the development of the modern naval fleet offers the most appropriate analogy. As ships grew larger and more complex, they required more massive and sophisticated bases in order to operate. As Bernard Brodie pointed out in his seminal work, *Sea Power in the Machine Age*: "The inventions of the last hundred years of change in the conditions of seapower brought about, among other things, a far greater dependence of the battle fleet upon its base and a sharp narrowing of its range of action."[6] To permit less constrained fleet operations in World War II, the U.S. Navy implemented the "fleet train" concept, whereby underway replenishment permitted naval battle groups to operate far from major bases. Except for the range enhancement offered by aerial refueling, American tactical airpower has followed in the footsteps of the U.S. Navy to become almost totally dependent upon sophisticated bases, which in turn has led to "a sharp narrowing of its range of action." But so far the Air Force has not developed an air force equivalent of the Navy "fleet train."

In the past, tactical aircraft possessed strategic mobility—though constrained by the lack of aerial refueling, they certainly could operate almost immediately from austere bases. Indeed, in World War I, most bases were simply evacuated cow pastures or meadows.[7] In World War II, the same held true, except for such large aircraft as the B-17 and B-29s. Many airbases in Britain, for example, were meadows or pastures sometimes covered with wire netting to limit field damage. As one former U.S. fighter pilot stated: "My P-51 base consisted of a

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[4]Fuel requirements are treated in more detail in Sec. I. The above figure is derived from assuming an 80 percent operational ready rate and two sorties per day.

[5]Munitions requirements are treated in more detail in Sec. II. This is assuming an 80 percent operational ready rate, two sorties per day, and the firing of two Sparrows and two Sidewinders per aircraft sortie.

[6]Brodie, 1943, p. 11.

[7]The British, for example, lost a surprising number of aircraft in World War I to collisions with cows. See Cooper, 1982, p. 132.

grass field, a bunch of tents, and some drums filled with gas. We could move the whole shebang in about a day."[8]

Throughout the war, tactical airpower possessed great mobility. During the Norwegian operation in April 1940, the Germans seized airfields in Norway with tiny airborne forces and immediately began using the airfields for operations.[9] In the North African campaign, airpower was used for a series of leapfrogging movements; as British Air Marshall Tedder told General Hap Arnold: "[It was] a battle for airfields. Lose them, and you retreat. Hold them, and you advance."[10] Yet this was predicated upon the fact that aircraft could rapidly begin operations from these fields. The advantages of such rapid mobility in North Africa were demonstrated in the British "Operation Chocolate," whereby a *complete wing* of Hurricane fighter-bombers was placed behind German lines to attack rear areas. An abandoned airfield was scouted and found suitable; that same day, 12 transports brought in the necessary supplies. Two days later, the Hurricane wing landed at the new base along with 12 transport aircraft. Two hours after landing, the Hurricanes took off and began interdicting German rear areas. After four days of successful operations, the British decided that the Germans would soon find the base, and the entire wing was withdrawn *within the day*.[11]

The U.S. Army Air Force conducted a similar operation during the Torch landings of 1942. American airborne troops seized Mehdia airfield just outside Casablanca, and that night P-40s from the carrier *Chenango*, along with their maintenance personnel and support equipment, flew in to the damaged runway. They began operations the next day.[12] During the Burma campaign in March 1944, the British airdropped bulldozers 150 miles behind Japanese lines to clear a landing strip, which was in use the next day by transport aircraft. The Japanese did not know of this development for a full week.[13]

The development of jet aircraft seems to have moved the United States away from the idea of rapid mobility for tactical airpower. This could have dangerous ramifications for USAF's ability to conduct operations in Southwest Asia. In the initial stages of the Korean War, the AF commander, General Partridge, soon found that the airfields in Korea were too austere to permit the operation of F-80 jets.

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[8]Conversation with Colonel F. Kosacka, USAF (ret.).

[9]Higham, 1972, p. 102.

[10]Arnold, 1949, p. 324.

[11]See Grant and Cole, 1979, pp. 119–121. The information in the book is based on RAF archival sources.

[12]Arnold, 1949, p. 352.

[13]Higham, 1972, p. 117.

Accordingly, he was forced to deploy F-51 *Mustangs*, because these were *the only American fighters capable of operating from the existing bases in Korea*. And a group of F-80 pilots were forced to abandon their jet aircraft in Japan, check-out in F-51s, and use these prop-driven aircraft for a time in Korea.[14]

The recent case of the Falklands also offers another instructive example of the possible repercussions when tactical airpower is unable to use existing bases rapidly. In the 1960s, the Argentine Air Force, when modernizing its tactical air forces, was faced with a choice between Mirage IIIs, F-5s, and the British Harrier. The Argentines chose Mirages. Had they chosen either F-5s or Harriers, they could have been able to use the small airstrip at Port Stanley[15] to base some of their fighter-bombers, and this in turn would have made it much more difficult for the British to recapture the islands.

U.S. military strategy dictates that U.S. aircraft must be given much greater mobility. To develop such a capability, the Air Force must develop a concept of operations, which in a broad sense is a clear plan of how it will achieve such a capability. In essence, the system that supplies aircraft with fuel, ammunition, and maintenance support must be made as lean, flexible, and mobile as possible. The operational concept must provide diversified methods of supplying such bulky and heavy consumables as fuel and ammunition. At the same time, it must find ways of reducing aircraft maintenance requirements in order to decrease the amount of personnel and ground equipment currently needed to maintain aircraft. The following suggests in more detail some possible methods of providing U.S. aircraft with greater mobility.

CONCEPT ELEMENTS

Fuel

Without fuel, the Air Force cannot fight, and having only limited fuel may cause a shift in traditional concepts of force employment.[16] The ability to supply fuel rapidly to deploying aircraft must therefore form a major part of this concept. To get some idea of the situation,

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[14]Futrell, 1961, pp. 104–106.

[15]Assuming of course that they could have transported in sufficient maintenance equipment and supplies. This seems likely, because the Argentines were able to base Pucara ground attack aircraft and Hercules transports on the island.

[16]For example, in World War II, the China-based 14th Air Force was forced to curtail its heavy bomber operations because of the heavy fuel consumption of these aircraft. It also employed more P-51s rather than the more numerous P-47s because of the former's better fuel economy. See Weaver, 1982, for a useful insight into the effects of fuel constraints on airpower employment.

an F-15 with Fast Pack conformal tanks carries about 3,200 gallons of JP-4 grade fuel, a mixture of naphtha and kerosene. Assuming an operational ready rate of 80 percent in theater and two sorties per day that use up all but 5 percent of each aircraft's fuel,[17] a squadron would require 115,520 gallons per day, or 3,465,600 gallons per month.[18] A wing of F-15s under the same conditions would require 10,396,800 gallons of fuel per month. Such a quantity would cover a football field to a depth of 48 feet in JP-4 and require about 1,660 truck deliveries per month or 561 rail tankers per month. This is a lot of fuel. Further, the other services would require other types of POL; a mechanized division, for example, uses some 4,284,000 gallons per month.[19] Vietnam may provide some idea of overall POL requirements; in the late 1960s, the United States used over 120 million gallons per month, which if stored in one place would cover a football field to a depth of almost 600 feet.[20]

Local Fuel Storage. To supply fuel requires planning on several fronts. Perhaps the most obvious solution is to use fuel that is already in theater, and, indeed, a major component of U.S. basing policy is to encourage regional nations to develop local fuel storage facilities. This policy requires no outlay of U.S. funds and it benefits from the desire of regional nations to develop their own industrial infrastructure. Military bases and international airports in the Gulf will certainly possess substantial storage facilities and stocks of fuel, which would play a central role in supporting U.S. combat forces. U.S. policymakers must make clear to nations in the region what amounts and types of fuel the United States would need to more effectively defend the Gulf.

One disadvantage of this policy, however, is that there will always be some uncertainty as to the actual amounts of fuel in storage in the theater. Further, these sites, like all POL sites, would form lucrative and vulnerable targets. As Dews has pointed out, even hardened POL sites with blast walls and indigenous firefighting units, such as the Germans had in World War II, are extremely vulnerable.[21] Although the ranges involved would necessarily constrain Soviet air attack capabilities, the Soviets could employ precision guided munitions fired from their long range bombers or use commando teams or agents to sabotage these facilities. Regional air defenses in combination with U.S. air

[17]This would permit a 5 percent reserve for emergencies.

[18]These amounts of fuel may be low estimates, because sortie rates could be higher under combat conditions.

[19]*The Rapid Deployment Force*, Defence Marketing Service, 1980, p. V-12.

[20]Dunn, 1972, p. 128.

[21]See Dews, 1980. The Germans went to great lengths to harden their POL sites, but to no avail. Petroleum fires are extremely difficult to stop from spreading.

defense efforts could aid in diminishing the air threat, and other measures (guards and sensors) could reduce the sabotage problem. In many ways, of course, the problem of defending these POL sites is easier in Southwest Asia than in NATO, given the distances Soviet aircraft would have to cover.

Local Refining Facilities. A related option in supplying sufficient fuel would be to use the products of refining facilities in the area. Refinery capacities for Gulf nations that may act as allies in the event of war are as follows (barrels per year for 1980):[22]

Nation	Refining Capacity (crude)
Abu Dhabi	13,500,000
Bahrain	250,000,000
Kuwait	645,000,000
Qatar	10,788,000
Saudi Arabia	487,000,000
Total	1,406,288,000

Naphtha and kerosene are both natural products of the distillation process. Middle Eastern crude typically yields 12 percent kerosene (though this can be increased through refinery procedures) and sufficient naphtha to produce JP-4, and the refineries listed above could produce at a minimum over 168 million barrels of JP-4 per year or approximately 14 million barrels per month (some 588 million gallons).

It is unlikely, however, that the United States would have access to all these refineries. Yet enjoying the use of a single refinery would greatly ease the situation. For example, the Ras Tanura refinery in Saudi Arabia cracked over 12 million barrels of kerosene in 1981 (504 million gallons).[23] That refinery could supply about 40 million gallons per month, or enough to support almost four wings of F-15s over that time period.

The major problems with indigenous facilities would be the possibility of damage in combat (and, indeed, the Soviets would probably regard them as a vital target), difficulties in maintaining full

[22]Drawn from *International Petroleum Encyclopedia*, Penwell Publishing, Tulsa, 1980, p. 396. Other nations in the region, such as Iran, Iraq, and Lebanon, have a refinery capacity, but these have been damaged due to war and unrest. Further, some of the nations owning refineries, such as South Yemen, are actively hostile to the United States. Other states owning refineries, such as Israel, Jordan, and Egypt, are located too far from the scene of conflict to aid much in supplying the air battle over the Gulf.

[23]*Aramco Fact Book, 1981.*

production (due to manning or technical difficulties), or the possibility that the owning nation may not permit access. There would still be some difficulties involved in intra-theater distribution, although several options discussed below could alleviate this problem.

Pre-positioned Fuel. Another obvious solution is the pre-positioning of fuel, and a substantial portion of U.S. investment in regional facilities and Diego Garcia has gone into fuel storage facilities. This appears to be one of the most cost-effective measures that can be taken to improve Central Command's fighting capabilities. For example, it costs about 100 FY84 dollars per barrel to construct fuel storage facilities in Southwest Asia;[24] $10 million would be needed to build a single 100,000 barrel facility (4,200,000 gallons); and with an F-15 wing consuming 10,944,000 gallons per month, it would cost approximately $25 million to support the wing for one month.

Whether sufficient POL can be pre-positioned, even at seemingly modest cost, is a matter of some doubt. In the first place, Congress has so far proved reluctant to grant sufficent base development funds in the area because of the familiar problem of insecure access agreements. Second, other theaters also require attention; in Europe, for example, U.S. main operating bases have adequate supplies of fuel, but it was reported that only 19 percent of U.S. collocated operating bases have "minimum essential facilities" (dispersed parking and seven days of fuel and ammunition).[25] In the Vietnam conflict, the United States began with an in-place storage capacity of 67.2 million gallons. Even after prodigious efforts over several years, however, storage capacity was increased to only 109.2 million gallons, which was still deemed by the services to be 75 million gallons below requirements.[26] In short, it seems unlikely that the United States will ever be able to pre-position enough fuel to support its requirements; hence, it must rely more heavily on indigenous support and other measures.

Sealift. Another method for providing POL would be to bring it in by sea in tankers. Although sealift is slow, it would be possible to send fuel-laden tankers to the area before the start of hostilities. This would not be as escalatory a step as moving combat forces and could probably be concealed, because dozens of tankers ply the regional sea routes every day. Tankers are very efficient fuel carriers. Assuming,

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[24]Data derived from cost estimates laid out in *Subcommittee of the Committee of Appropriations, Military Construction Hearings, HAR*, Part 5, pp. 150–153. For example, a 31,500 barrel POL site at Masirah is estimated to cost $3 million; a 63,000 barrel site $6 million. Facilities in Southwest Asia cost roughly two to three times as much as CONUS-based facilities.

[25]*Aviation Week & Space Technology*, 7 March 1988, p. 22.

[26]Dunn, 1972, p. 128.

for example, that a 100,000 deadweight ton tanker had been "scrubbed" to permit the transport of JP-4,[27] such a vessel could supply almost 30 million gallons of fuel, or enough to support three wings of F-15s for one month.

The major problem would be delivering the fuel from the tanker over the shore to the recipient airbase. Given the size of modern tankers and the generally shallow coastal waters in the region, offshore discharge facilities would be most useful. One option would be to use existing discharge facilities in the region; the following were in operation in 1980.[28]

Nation	Number of Single Point Moorings
Oman	4
Qatar	6
Kuwait	3
United Arab Emirates	8
Saudi Arabia	7
Dubai	1
Iran	6

Rapid Discharge. These facilities might be unavailable because of enemy action or for political reasons and also might not be in useful locations. Thus the capability to install a discharge facility rapidly could be vital. The appropriate equipment for this exists now. Essentially, a mooring buoy at which the tanker could anchor would have to be installed with a pipeline running to the shore and thence to the airfield. As tankers have increased in size, offshore discharge facility technology has become much more advanced. At present, one U.S. company, IMODCO, produces portable mooring buoys, which can be transported in C-5As and be hooked up by flexible rubber hoses in a matter of hours. The time required for deployment is based largely upon the length of pipeline needed; the rubber pipe comes in lengths of 35 feet and must be bolted together. A mooring facility costs roughly $3 million and could be deployed worldwide. The U.S. Navy has pro-

[27]Most large tankers carry only crude, which would contaminate JP-4.

[28]*International Petroleum Encyclopedia*, 1980, p. 294. Capacity varies according to pipeline diameter.

cured one such system and conducted a five year test program. It soon may buy a total of ten.[29]

Adequate stocks of rubber hose must be procured, because no U.S. company produces the flexible rubber hosing used for temporary offshore facilities.[30] This hose could also be pressed into service to aid in intra-theater fuel distribution. A sufficient stockpile based in the United States or Diego Garcia would be a prudent policy (the hose costs $200 per linear foot or $1 million a mile).

Fuel Storage. Yet even if the United States were able to transport sufficient fuel to bases in the region, it must have something to store it in. Regional storage facilities would obviously play an important role, but the United States must also hedge against the possibility that these local facilities will have suffered damage or prove inadequate for requirements. Rubberized fuel bladders are an obvious answer. Although less durable and certainly more vulnerable than permanent facilities, they offer the great advantage of rapid erection—a bermed pit must be dug (for protection and strength) and then the bladders can be filled.

Some study must examine the issue of how many bladders to procure, because the current stocks appear inadequate. It would not be necessary to procure *sufficient* bladders to support the entire force for a month, as tankers or trucks could bring in new supplies of JP-4 on a regular basis; but an increase in bladder stocks would provide greater operational flexibility and the ability to compensate for erratic supply. Fortunately, bladders are inexpensive. Aero-Tec Laboratories, for example, produce bladders holding 100,000 gallons. They come on pallets that can be carried in C-130s, for a cost of $31,000 per bladder. For some $10 million, the Air Force could procure about 330 of these bladders, which would hold some 33 million gallons of fuel (enough for three wings of F-15s for a month). Procuring adequate peacetime stocks of these bladders would seem to be a prudent policy, because a three-shift team at Aero-Tec can produce only six per week.[31]

Aerial Refueling. Another suggested method of dealing with the POL problem would be to use aerial refueling (see Fig. 6). This has the great advantage of permitting the United States to pre-position large quantities of fuel at Diego Garcia and thus alleviate the dangers of base denial (and, through developed defenses, POL vulnerability). Further, given base access to nations on the fringe of the theater—such

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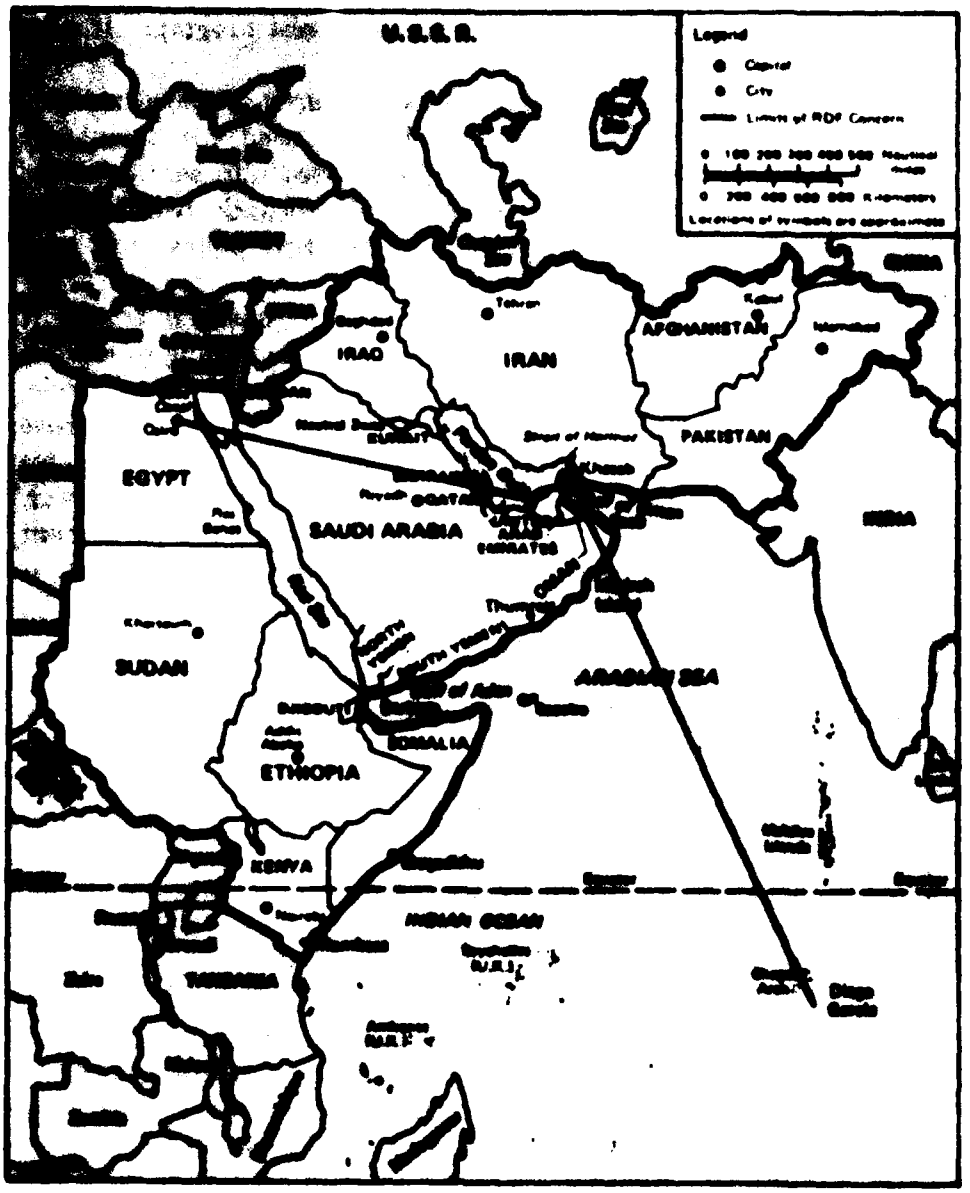
[29]Interview with Derek Bradstreet of IMODCO, 1983.

[30]Six companies based in Europe and Japan are the only ones that produce rubber pipeline.

[31]Information on these bladders gained from March 1983 telephone interview with David Dusk of Aero-Tec Laboratories in Ramsey, New Jersey.



SOURCE: Adapted by Congressional Budget Office from U.S. Department of Defense Annual Report FY82

Fig. 6—Possible tanker operations in Southwest Asia

as Israel, Jordan, Egypt, or Somalia—tankers could operate out of these rear area bases and there would be less need for massive fuel dumps at forward airbases.

Say a wing of Fast Pack F-15s is based in Oman to provide aircover—indeed, this would probably be a first priority during initial hostilities. Given the possible inadequacies of local fuel supplies, one method would be to fly these fighters off without a full fuel load and refuel them from tankers based in Cairo or Diego Garcia.

If KC-10s were based in Cairo and flew to an orbit above the United Arab Emirates, where they loitered for roughly one hour, such a mission would be 3,700 miles long. Accordingly, a KC-10 could offload 220,000 pounds of fuel.[32] Now if the F-15s took off with only 25 percent of their normal fuel load and consumed all but 5 percent of it in linking up to the tanker, they would each need about 20,000 pounds of JP-4. Assuming that each refueling would take some five minutes (which may be optimistic), each KC-10 could support eleven F-15s.[33] Given similar conditions with KC-10s operating from Diego Garcia, each tanker could support 10.4 fighters.

Aerial refueling, although possible, would place another burden on U.S. tanker assets, which would also be engaged in supporting the transport fleet and long range combat aircraft. And aerial refueling would require a great deal of radio communications during the mating process between tanker and recipient aircraft, which could reveal positions and force size to enemy listening posts. As one officer stated in a recent book about tanker operations in Vietnam: "I have never heard so much chatter concerning ranges, bearings, locations of aircraft, etc. . . . Putting it bluntly, the enemy should have little difficulty determining force size and location at any given time."[34]

There is no simple solution to supplying fuel, but many measures are available. Obviously, a mix of supply sources is needed, with indigenous facilities and production, pre-positioning, seaborne tankers, bladders, temporary pipelines, and aerial refueling contributing wherever possible. Flexibility and improvisation in supplying fuel will be crucial in enabling the Air Force to play a powerful role in Southwest Asia.

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[32]KC-10s or KC-135s operating in buddy configuration could increase the amount that could be offloaded. For some interesting analysis on these buddy operations, see Anderson, 1982.

[33]Actual numbers of F-15s would probably be lower, because of extra fuel consumed by the tanker in linking up operations, evasive routing, and the difficulty of linking up in such short periods of time.

[34]See Hopkins, 1978, p. 37.

Munitions

Munitions are another consumable that must be supplied rapidly to tactical air assets in the theater. Standard Air Munitions Packages (STAMP), which are standardized palletized loads of munitions, are the usual means of doing this. These are stored in CONUS, Europe, the Far East, and elsewhere. They could be airlifted in from such regions to selected bases in a theater.

Supplying air superiority aircraft with sufficient munitions by airlift from the CONUS would not be too much of a problem. Assuming 80 percent mission ready rates and two sorties per day for all the F-15s and half the F-4s assigned to the Central Command force "reservoir," and the firing of half of the standard missile load of these aircraft, the total force would require 344 AIM-7 Sparrows and 344 AIM-9 Sidewinders per day.[25] In these conditions of rather high consumption, the total force would need only four C-141B sorties per day or 1.7 C-5A sorties per day to supply the force with sufficient missiles.[26]

Supplying the interdiction aircraft would be more of a problem. The entire TACAIR interdiction force could deliver some 845 GBU-15s per day. These munitions would weigh 950 tons[27] and require either 35 C-141B sorties or fourteen C-5 sorties per day. Given the competing demands placed on the U.S. airlift force, it seems unlikely that airlift alone could support such a large interdiction force. However, airlift could support a smaller interdiction force if required in the early stages of a campaign for control of the Gulf. For example, a wing of F-111s, the most capable and longest-range interdiction aircraft in the U.S. inventory, could require some 322 tons of GBU-15s per day.[28] This could be supplied by only 11.7 C-141B deliveries or some 4.6 C-5A deliveries per day.

A larger interdiction effort could be supported through the use of munitions that are already in-theater, such as those supplied to regional air forces or pre-positioned at bases where the United States

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[25]Standard air-to-air missile armament for F-15s and F-4s is four AIM-7s and four AIM-9s. Accordingly, the assumed force of 108 aircraft could mount some 172 sorties per day and, with each aircraft firing two AIM-7s and two AIM-9s, the force would need 344 of each missile per day. Such consumption rates may be high, but these rates would not be difficult to support by airlift from the CONUS.

[26]Sparrows weigh 500 lb each, Sidewinders 200. Total daily munitions would weigh 240,000 lb or 120 tons. Assuming 27.5 tons per C-141B sortie (the usual weight carrying load of C-141Bs for bulk cargo) results in about four sorties per day. The re-winged C-5As can carry on average 68.9 tons of such bulk cargo per sortie.

[27]Each GBU-15 weighs 2,240 lb.

[28]Assuming a wing has 80 F-111s, 80 percent operationally ready rates, flies one sortie per day, and delivers four GBU-15s per sortie, the wing would require 322 GBU-15s per day.

has negotiated contingency access agreements. Sealift could also provide large amounts of munitions; an ammunition ship based at Diego Garcia, for example, could arrive off Oman within six days.

Supplying sufficient munitions by airlift for air superiority missions is well within U.S. capabilities. Although the interdiction mission is equally important, the logistical difficulties may make the Air Force place priority on the air superiority mission, at least in the initial stages of the campaign, because this would require the least number of airlift sorties to haul in munitions. Allocating some airlift sorties to supply a small part of the U.S. force with the most effective ground attack munitions available will also yield greater operational flexibility.

Austere Field Capable Aircraft

To fight in Southwest Asia, the USAF must be able to operate out of regional bases. Supporting tactical aircraft at these bases would present many difficulties, because although developed airfields (international airports or military bases) would probably contain some fuel, beddown space, and hangars, there would necessarily be an extremely limited amount of standard maintenance equipment. Very few air forces in the region own American-made aircraft and the required maintenance facilities, except for Saudi Arabia (F-15s, F-5s), Iran (F-4s, F-5s, F-14s), Jordan (F-5s), Egypt (F-4s, F-16s), and Israel (F-4s, F-15s, F-16s, A-4s).

As part of the operational concept being developed here, it is critical to realize that aircraft and bases are part of a system that produces sorties; essentially, less reliable and less self-supporting aircraft require increased numbers of maintenance personnel and greater amounts of support equipment. This in turn increases the time required to deliver and set up the necessary equipment needed to support aircraft. It also raises the amount of food, water, and spares that must be supplied regularly to keep the force operational.

With the possible exception of the A-10 program, U.S. procurement of modern tactical aircraft has generally emphasized combat performance rather than aircraft maintenance requirements and austere field capability. Several modifications should be studied to improve matters in two ways. First, the dependence of U.S. tactical aircraft on base support facilities should be decreased so as to reduce personnel requirements and the amount of support equipment that must be present in or transported to the theater. This would also decrease both the vulnerability of the force to disruption of lines of communication and the time it would take to begin sustained operations. Second, the reliability and maintainability of U.S. aircraft should be increased to produce higher

numbers of operationally ready aircraft, thus multiplying the effectiveness of the force.[39]

Reducing Support Equipment and Personnel

Decreasing the amount of equipment required to support tactical aircraft would have several advantages for Southwest Asia. First, it would reduce U.S. vulnerability to interdiction of its lines of supply; second, it would reduce personnel requirements; and third, it would reduce the amount of material that would be needed in the theater to begin operations. Taken together, these measures would ease deployment and redeployment problems.

U.S. aircraft, like most aircraft, are dependent upon base equipment that is capable of producing such hard-to-handle materials as Liquid Oxygen (LOX), nitrogen, and hydrazine.[40] For example, all U.S. tactical aircraft depend on internal tanks filled with LOX to supply air to the pilot. This in turn requires either LOX generation facilities at airbases or purchases of LOX from local producers. Without LOX, U.S. aircraft would not be capable of performing effectively, because they would be restricted to low altitude flight. In recent years, however, technology has created On Board Oxygen Generating (OBOG) equipment, which largely does away with the need for LOX generating equipment on the ground and provides better quality air.[41] Using a molecular sieve to concentrate oxygen and remove nitrogen from ambient air, the OBOG unit fits into the same service tray as a LOX tank. It also weighs the same.[42] Reliability is also quite high—on preproduction models, based on some 8,000 hours of testing, MTBF (Mean Time Between Failure) rates stand at 1,000 hours (some five months of combat flying) and are planned to be raised to 4,000 hours.[43] The Navy currently plans to fit Harriers with OBOG equipment, and the Clifton Precision Company has installed a similar unit in an F-16

[39]For example, 72 F-15s at 80 percent mission ready rates flying two sorties per day could generate 115 sorties per day: (72 × .80) × 2 = 115. Increasing readiness rates to 90 percent would generate 129 sorties per day. It would require the addition of nine F-15s (12.5 percent more aircraft) at 80 percent operationally ready rates to generate similar numbers of sorties. At the same time, of course, increasing OR rates could require major increases in personnel, support facilities, and spares, which may be counterproductive.

[40]Much of the technical information below is derived from Berman, 1983.

[41]OBOGs generated air contains more argon.

[42]The OBOG unit manufactured by Clifton Precision Instrument and Life Support Division weighs 30 lb and measures 11" × 12" × 11". R. Hradeck of Clifton Precision provided information on OBOG.

[43]The major failures have occurred in the gear train to a motor driven valve, but this problem has been rectified. There have been no failures in the molecular sieve.

to demonstrate the feasibility of retrofitting. The Air Force plans to install four more units on F-16s for further testing. Should production be authorized, each unit would cost between $10,000 and $20,000.[44]

OBOG does require a backup system in the event of failure, such as compressed gaseous oxygen or small amounts of LOX, but it could almost eliminate the need to find local supplies of LOX in the area. It would reduce the number of transport sorties required to establish airbases, because LOX generating facilities weigh many tons, require fuel for operating, and are also extremely hazardous to transport.[45] Third, it would reduce the vulnerability of deployed aircraft. For example, should the airlifter bringing in the LOX equipment crash, tactical aircraft would have great difficulty in performing regular combat missions. Such an occurrence apparently took place in 1980 during an exercised deployment to Egypt, and it took some time to replace the lost equipment.[46] Equipping the entire TACAIR force with OBOG equipment is not necessary, because the United States can still count on the use of Main Operating Bases (MOBs) in NATO and the Far East. However, some serious consideration should be devoted to equipping aircraft designated for Southwest Asia with this new equipment.

It is standard practice in the Air Force to use nitrogen in tires and hydraulic struts, because it oxidizes aircraft parts very slowly and permits longer equipment life. Yet this means that the United States must have access to a local supplier of nitrogen or deploy nitrogen generating equipment, which adds more potentially hazardous material to airbase requirements. It might be prudent to plan to use compressed air instead of nitrogen for filling tires and struts temporarily during the initial deployment phase.

At the same time, self-starting aircraft would permit more autonomous operations by freeing aircraft from start carts and ground power. Newer U.S. aircraft, such as the F-15 and F-16, can self-start using a jet-fuel starter, but they still need ground power to supply electric and hydraulic power during ground checkout and to supply cooling air for the avionics equipment during checkout. An internal auxiliary power unit could be added to permit more autonomous operations.[47]

Older U.S. aircraft, such as the F-4 and A-7, require "start carts" to start their engines. With these aircraft, it may be possible to develop a self-starting capability with the addition of only a few pounds by

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[44]The OBOG equipment could be retrofitted into each aircraft, although it would be more cost effective to install them on the production line.

[45]For a perspective on this, see Gross, 1982, p. 18.

[46]Halloran, 1980, p. 18.

[47]At present, systems checkout can be accomplished by running the main engines, but this is dangerous and also limits access to some parts of the aircraft.

modifying the emergency air start system. For example, the new Northrop F-20 was initially designed for only air self-start in the event of an emergency; but engineers found that adding only some 20 pounds of weight permitted the addition of sufficient hydrazine fuel to allow ground self-starts as well as air starts.[48] Hydrazine is highly toxic and it might be possible to substitute a mixture of jet fuel and oxygen instead (the latter ingredient provided by the OBOG unit).

Tires are procured on the basis of a curve that established the most cost-effective tradeoff between tire life and cost (longer wearing tires cost more). This means that a standard F-16 squadron has an operational requirement for several thousand pounds worth of tires (which require more transport sorties, because of the bulk). In designing a quick deployment force, these aircraft could be equipped with longer wearing tires so that so many transport sorties do not have to be used up on such an item. Another possibility to consider would be to design tires with snap-on replaceable treads; when the tire wore out, the lighter, less bulky tread could be replaced quickly at the base.[49]

Loading weaponry on tactical aircraft at present requires complicated heavy munitions carts, which use hydraulic loaders to place munitions on pylons. Some air forces, such as the Israelis and the Swedes, use simplified mechanical bomb loaders. With these simplified loaders, Israeli aircraft being readied for ground attack missions can be turned around in 7–10 minutes, rather than the standard 25 minute turnaround of U.S. aircraft.[50] It may also be possible to design mechanical munitions hoists that are built into the pylon, further decreasing the required amount of ground equipment.

In general, the demands of the Southwest Asian theater require some selected modifications to aircraft and careful consideration in the development of future tactical aircraft. Essentially, air combat performance may decrease somewhat, since increasing the capabilities of tactical aircraft to operate with less support equipment may increase the weight of the aircraft, decrease its fuel fraction, or increase wind resistance.[51] Nonetheless, the ability of the aircraft to carry out its missions would increase.

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[48]Personal communication. A start cart might prove more effective over a longer period of time, because it would provide thousands of starts.

[49]The snap-on tread concept is developed in Berman, 1983.

[50]U.S. turnaround times taken from *Final Report on the Coronet Eagle F-15A/B Deployment*, TAC HQ, Langley, 1981. In comparison, Arab turnaround times averaged 3–4 hours. The Israelis have introduced several ideas to speed up the turnaround times of their aircraft to "multiply" the effectiveness of their force.

[51]M. Berman at Rand is working on a project that uses a "rubber aircraft" to analyze the costs and benefits of creating a more austere-field-capable aircraft.

The current bubble canopies on F-15s and F-16s offer an analogy. It was argued successfully in the late 1960s that all-round visibility was necessary for pilots to fight effectively, even though the raised bubble increased wind resistance. In regard to the addition of conformal FAST PACKs (Fuel, Air, Sensor, Tactical PACKages) on F-15s, although these increased wind resistance and reduced top speed, they did permit the carrying of greater amounts of fuel or avionics gear, thus improving the aircraft's ability to carry out missions. A similar attitude must be taken in regard to designing aircraft for austere field operations.

Easing Maintenance and Improving Reliability

Decreasing the maintenance requirements of aircraft and increasing the reliability of aircraft components also offers many advantages for operations in austere areas. Operational ready rates could increase, thus multiplying the effectiveness of the force, and maintenance personnel and equipment requirements could decrease. This does not necessarily mean a new aircraft, but it could involve some limited and fairly inexpensive modifications. The object of these modifications would be to increase the amount of commonality in both maintenance tools and parts as well as to ease difficulties in conducting repairs. Some modifications could include:

- using common fasteners on all access panels, decreasing the need for specialized tools
- using common hinges on panels, easing replacement problems
- using interchangeable parts on such items as brake drums, landing gear struts, appropriate flying surfaces, decreasing the amount of material needed in the logistics pipeline[52]
- making often-removed access panels of more durable material (fiberglass panels often crack and require replacement)
- placing often-removed "black boxes" in easily accessible locations
- developing common lightweight ground maintenance stands
- developing a universal aircraft jack
- providing a standard length of easily joined ducting for repairs
- developing standardized hydraulic pipe fittings
- increasing the versatility of ground equipment.

[52]On the A-10, for example, many flying surfaces are interchangeable. On the F-16, many of the rear landing gear components are interchangeable.

Avionics reliability and the equipment needed to service the avionics have also been a growing concern in the Air Force. The powerful avionics in U.S. aircraft are an important "force multiplier" that the Air Force has developed to improve survivability and offset Soviet quantitative advantages. Yet maintaining the avionics systems requires a formidable amount of equipment. An F-15 squadron, for example, requires an Avionics Intermediate Shop (AIS) to perform black-box repair. The AIS diagnosing equipment requires three C-141B sorties for transport; the portable building, aluminum matting floor, and air-conditioning and power supply equipment require another three C-141B sorties. When erected, a process that takes five days,[53] the AIS takes up 4,500 square feet of air-conditioned space, uses a large number of spares itself to continue diagnosis operations, and increases vulnerability, because its destruction would severely reduce sortie generation rates.

Recent advances in digital technology as well as improvements in the methods of diagnosing and repairing "squawks" have demonstrated that great improvements are possible; Northrop's experiences with the new F-20 *Tigershark* and McDonnell-Douglas' findings with the redesigned avionics in the proposed F-15E *Strike Eagle* are certainly encouraging. For example, the Hughes APG-65 radar in the F-18 *Hornet* was required to demonstrate only an 85 hour MTBF (Mean Time Between Failure) during initial Navy testing, but two randomly selected radar units demonstrated a 149 hour MTBF,[54] equivalent to five months of peacetime operations.

Redesigning avionics systems also offers great potential for increasing reliability rates. Commercial airline avionics go through three redesign procedures known as the "maturation phase," to improve reliability. For example, the Delco inertial navigation system (INS) for use in commercial transports has a MTBR (Mean Time Between Replacement) of 1500 hours after the third redesign, up from only 100 hours after the initial design. The Air Force has had a similar success with the redesign of the Minuteman inertial guidance system. An F-15 INS, however, has only a 75 hour MTBR, largely because the system as originally designed was fitted into the aircraft.[55] Another possibility, of course, would be to dispense with electro-mechanical INS equipment altogether and rely instead on ring laser gyros, which perform the same

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[53]Information gained from Air Force personnel who participated in three practice AIS deployments.

[54]See "Hornet Radar Excels," *Flight International*, 2 July 1983, p. 10.

[55]An F-15 INS, of course, must withstand higher g-forces and has less warmup time than commercial INSs. However, improvements are obviously possible.

function and, because they have no moving parts, could considerably increase reliability.[1]

Some Air Force study has taken place on the possibility of refitting selected aircraft with avionics that have gone through the "maturation" process. The stumbling block is that the estimated cost of refitting the F-15 force is several billion dollars. If retrofitting F-15s with more reliable avionics is initiated, those aircraft assigned to Southwest Asia should be first on the list.

Other modifications could also aid matters. Improved engine reliability could be attained through some refitting, as is being carried out on the F-100/F-101 series of engines. Reliability rates will also be greatly improved for the new generation of jet engines currently being tested, such as the F-110 and PW-1128. New materials, such as tialuminates, silicon nitride, and carbon-carbon, can withstand the extreme temperatures of modern engines better than previous materials and also offer other structural advantages. New structural design of components using fracture mechanics also has increased reliability potential as do improved testing facilities and diagnostic tools. Further, advanced engines will have far fewer moving parts.[2]

Other avenues could also be explored more fully. For example, the Swedes considered buying F-16s and F-18s from the United States to replace their aging Viggen force. Sweden, however, has a unique basing system resulting from their assumption that at the start of any major conflict, all MOBs will be knocked out of action. Accordingly, the Swedes have set up a complex of 45 dispersed bases and require their aircraft to operate from these minimal facilities.[3] They are now enhancing the system under the "Base 90" concept. After examining the F-16s and F-18s, the Swedes developed a list of modifications to the aircraft to permit more effective operations from austere fields. According to engineers who participated in these discussions, none of the modifications would have driven the cost up much.[4] The Air Force could study the Swedish design modifications to get some ideas on how to improve the austere field capability of its aircraft, particularly as the accommodating Swedes have done much of the groundwork already and such an effort would involve very little expenditure of funds.

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[1]Further, ring laser gyros, which will be installed on the F-20 *Tigershark*, do not require a warmup time for alignment. For more information on these ring laser gyros, see Griffiths, 1988, pp. 6–7.

[2]For a very useful discussion of engine design, see Sweetman, 1988, pp. 788–790.

[3]See "Air Base System," Sweden: Ministry of Defense, 1979. My thanks for this information to Rand colleagues M. Berman and W. Stanley, who have been studying Swedish Air Force operations.

[4]Personal communications.

Another option to improve the austere field capability of U.S. aircraft, and one that would probably prove appealing to Congress, would be to set up an industry contest whereby each major manufacturer would be given a small sum of money to suggest ways to improve the austere field capability of, say, the F-15 force. Minimal guidance should be given to permit the greatest productivity, and the winner of the contest could be given the lion's share of the contract award to modify aircraft for operations. A prototype derivative competition would be an additional possibility.

Base Kits

The measures outlined above, combined with other initiatives, would reduce the total amount of equipment required to support U.S. tactical aircraft and also the number of personnel required to maintain aircraft. In combination, these initiatives would permit the development of smaller, lighter, and more rapidly deployable base kits, needed for housing, aircraft support, electrical power, lighting, and water supplies.

Setting up a base to support aircraft and personnel at an austere site using current base kits is a very complex operation. First, a C-141B must bring in an engineering team (from the various mobility support squadrons and the RED HORSE and PRIME BEEF teams) as well as all-terrain forklifts, which are needed to unload follow-on transports (the base kits come on pallets that can be unloaded only by heavy materiel handling equipment). Next, a tanker or transport aircraft must land filled with diesel fuel to operate the erection equipment and basic power generators.[5] These items cannot be air-transported with full fuel loads. A portable loading dock would improve the efficiency of offloading operations. Following this, portable aircraft hangars, maintenance facilities, and personnel barracks, more permanent power generating equipment, fuel bladders, and water supply equipment must be brought in and erected. Trenches must also be dug in order to protect water, fuel, and electrical lines. Concurrently, personnel from the deploying squadrons can begin installing their maintenance equipment, thus enabling aircraft to begin full-scale operations. The present time required to set up facilities for a squadron is 20 days; a wing requires 60 days.[6]

The process described above would be utilized in preparing for combat operations at a bare base. Obviously, most bases in the region

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[5]The initial generators used are 60 kw diesel generators, which are later replaced by more powerful mobile 750 kw gas-turbine generators.

[6]My thanks to the personnel of the 4408th Mobility Support Squadron and R. Coser and P. Dadant of Rand for their shared expertise in this area.

would contain more facilities than a bare base, but many of the steps described above would have to be taken in order to support combat operations. Electrical power requirements could be much greater than a site is capable of providing, the power at the base could be of a different voltage, and water and billeting facilities could be inadequate for supporting the levels of men and equipment required by Air Force units.

The Air Force at present has sufficient equipment to bare-base eight squadrons of aircraft through the use of Harvest Bare and Harvest Eagle sets, and the Air Force has in recent years requested additional funds to create sufficient sets to bare base 28 squadrons.[7] The Harvest Bare kits provide semi-permanent facilities for basing personnel and aircraft at austere sites; the Harvest Eagle kits provide facilities for the support of personnel only.

The Harvest Bare kits were developed during the Vietnam War so that the Air Force could set up portable bases for long-term operations, such as the United States experienced in Korea and Vietnam. They were not designed for rapid deployment, but for a gradual build-up. The Harvest Bare kits consist of two major elements: Base Augmentation Support Sets (BASS) and Main Operating Support Sets (MOSS). The BASS kits consist of expandable aluminum buildings for use as barracks, kitchens, latrines, and showers. The MOSS kits contain additional expandable buildings to house operations and maintenance administration teams, larger general purpose buildings for munitions or engine repair shops, and portable aircraft hangars (see Fig. 7).[8] The Harvest Bare inventory also contains a formidable array of electrical generating equipment, runway lighting sets, and water purification and supply equipment.[9] This equipment is stored in the dry desert environment at Holloman AFB, New Mexico, and maintained by the 4449th Mobility Support Squadron, which comes under the authority of the Twelfth Air Force.

Using this kit, a wing of F-15s would require 458 tons of buildings for personnel barracks, 48 tons of water supply equipment, 265 tons of electrical power generation equipment, 88 tons of air-conditioning equipment,[10] 100 tons of buildings for operations administration structures, and some 400 tons of buildings for aircraft support structures. In all, the equipment needed *simply to provide power, water, and shelter*

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[7] See *FY88 Senate Committee on Armed Services Hearings, Sea Power and Force Projection, Part 6*, p. 2998. Procurement is planned to be complete by the end of the decade.

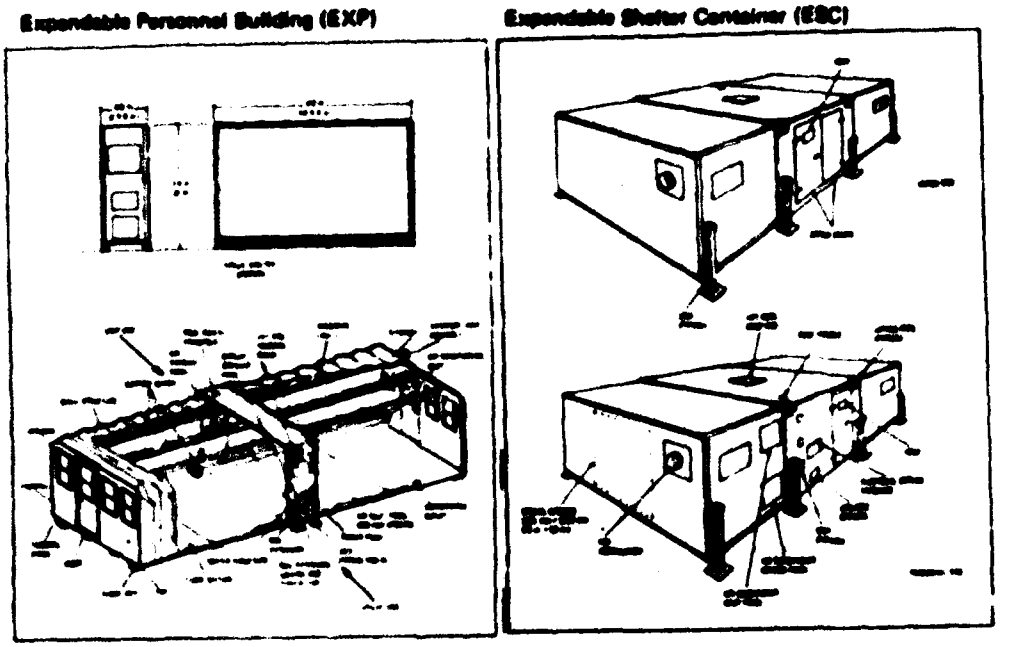
[8] The typical expandable buildings used for housing personnel and administration teams measure 28' × 12' × 8'. The general purpose buildings measure 48' × 28' × 12'. The hangars measure 120' × 76' × 28' and can house two F-111s (with wings swept).

[9] For descriptions of the equipment, see *Air Force Systems Command Design Handbook 2-6: Ground Equipment and Facilities.*

[10] The buildings used in the Harvest Bare sets are made of honeycomb aluminum and must be air-conditioned for desert use.

Expendable Personnel Building (EXP)

Expendable Shelter Container (ESC)



General Purpose Building (GP)

Aircraft Hangar (ACH)

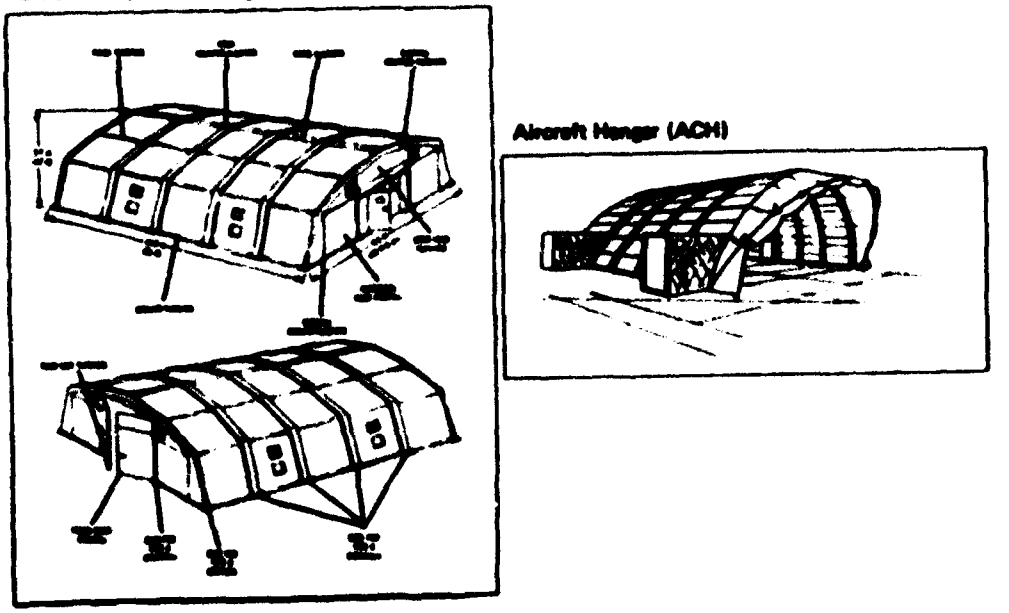


Fig. 7—Harvest Bare Equipment*

*Illustrations are drawn from *Air Force Systems Command Design Handbook 3–6: General Equipment & Facilities.*

would weigh 1,234 tons and contain, among other things, 128 small shelters, 20 general purpose shelters, and six aircraft hangars.[11] As the TACAIR logistics manual, *Base Operating Support at a Bare Base*, states, maintenance units for avionics, engines, and munitions "will provide the same support at a Bare Base as that normally provided at the home station."[12]

Erecting a base using these kits cannot at present be done very rapidly. The usual planning factor of 20 days per squadron and 60 days per wing is simply too long a time to permit deployment, particularly given the need for a rapid operational capability in Southwest Asia. The Harvest Bare kits, of course, were designed for different contingencies, resulting in facilities that perhaps are more "luxurious" than needed in the initial stages of combat. For example, the current Harvest Bare kits contain showers with individual water heaters, kitchens with mess halls, cutlery, food warmers, and dishwashers, latrines with incinerators, washer-dryers, and portable hard-walled barracks buildings that contain cots and built-in lighting. Similar hard-walled structures are also planned for use as administrative buildings.

Harvest Bare facilities have several effects that increase the time required for deployment. First, they weigh more than tents and hence require more airlift sorties. The hard-walled facilities currently planned for use as personnel and administrative buildings for a wing at an austere site weigh 559 tons alone (some 20 C-141B sorties). Second, because the walls are made of honeycomb aluminum, the structures must be cooled in hot climates. This requires some 88 tons of air-conditioners and greater amounts of electrical power. This in turn increases the time required for deployment, because more elaborate electrical power facilities must be transported and erected.[13] And sending in showers, latrines, and kitchens greatly increases the amount of water, power, and fuel to run such facilities.

The other base kit developed by the Air Force is the Harvest Eagle. These sets are essentially tent cities that provide less permanent facilities for personnel (tents, electrical power, and rear area lighting) than the Harvest Bare equipment. They do *not* provide facilities for maintaining aircraft, and in essence, they can be compared to the BASS portion of the Harvest Bare kits. The Harvest Eagle kits are stored at

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[11]Information obtained from the 4449th Mobility Support Squadron at Hellenman AFB.

[12]See *Base Operating Support at a Bare Base*, Tactical Air Command Manual 400-3, 30 October 1978.

[13]The very powerful 750 kw generators, for example, put out 4,160 volt current and because of the danger, the cables must be entrenched.

Robins AFB in Georgia and maintained by the 4400 Mobility Support Flight.[14]

As a near-term mobility enhancement measure, combining the Harvest Bare and Harvest Eagle kits, which are sited at two different locations and maintained by two different squadrons under two separate Air Force divisions, would bring many advantages. A modified Harvest Eagle package that could provide living and administrative quarters for the personnel attached to a wing, for example, would weigh 232 tons,[15] rather than the 647 tons a Harvest Bare kit would weigh to perform the same function.[16] By this step alone, the personnel shelter tonnage would be cut by almost two-thirds. Further, less electrical power generating equipment would be required, because there would be less need for air-conditioning.[17] And should modified aircraft that require less base support be procured, personnel requirements could decrease even more, and the number of hard-walled buildings that at present are needed to support aircraft could also decrease, along with power needs. Accordingly, less transport sorties would be needed to bring in equipment and less time would be needed to set it up. A longer-term mobility tool in regard to temporary base buildings would be to examine the structural possibilities offered by lightweight high-technology building material.

Another option would be to study the A-10 and Marine concept of basing more closely, because this reduces the amount of equipment required at forward bases. The A-10 basing program is configured to support A-10s at forward locations in Europe until specific aircraft require repairs that are beyond the capabilities of austere forward sites. These aircraft would then be flown to rearward locations for overhauls. The Marine concept is similar to the A-10 basing concept in that aircraft are flown from forward austere bases, fly sorties until the aircraft begins to fail, and then are returned to the more developed base (a carrier) for overhaul and maintenance.[18]

Variations on this rear-area depot concept could offer many possibilities in Southwest Asia. For example, instead of establishing an AIS

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[14]Data derived from TAC Regulation 400-12, *Harvest Eagle Logistical Management*, March 1977.

[15]This is assuming that heaters would not be brought along and that the Harvest Bare kits would supply electrical power and lighting. For specifications and equipment weight, see TAC Regulation 400-12, *Harvest Eagle Logistical Management*, 18 March 1977.

[16]This weight includes the required air-conditioning equipment.

[17]Interviewed personnel who had served in tents in the desert stated that they came to prefer the tents to the air-conditioned shelters after they had become acclimated to the heat. They said that stepping in and out of air-conditioned shelters made it very difficult to become acclimated.

[18]See "Mastery in Marine Harrying," *Air Enthusiast*, February 1978, p. 69.

facility at a forward base in the region, it might be possible to set up the AIS facility at Diego Garcia or another rearward base, such as Ras Banas or Cairo West. Airlifters could bring in failed Line Replaceable Units (LRUs) for repairs and, after maintenance, transport the repaired LRUs to the forward base for installation. Diego Garcia, for example, is 2,250 n mi from Oman, or a five hour sortie by a C-141B.

Finally, there must be more extensive testing and exercising for austere basing operations. Personnel who participated in the Bright Star exercises, where temporary bases were set up in Cairo, stated that the experiences were invaluable and exposed many deficiencies that have since been remedied. Continued practice deployments could offer many benefits, particularly should the Harvest Bare and Harvest Eagle kits be based at one location and placed under the authority of a single Air Force. "Paper simulations" of deployments would also be less expensive than actual deployments and help keep the "corporate memory" strong.

Fewer Types of Aircraft

Another method to increase the mobility of TACAIR would be to take a hard look at the number of different types of aircraft that the Air Force plan on sending to Southwest Asia. The current TACAIR force consists of F-111s, F-15s, F-4s, A-10s, and A-7s. Except for the F-4s, each of these aircraft is dedicated to a specific mission. This means that there are five different types of tactical aircraft, each of which requires different maintenance procedures, equipment, and personnel. One rather simple method of cutting down on the amount of equipment needed would be to send fewer types of aircraft to the region, particularly in the initial stages of operations. For example, such a force would include F-111s, because they can conduct long range interdiction operations during both night and day. To supplement the F-111s, however, one other type of aircraft, such as the multi-mission F-16s, F-4s, or possibly the derivative F-15E or F-16E could be used to fly air superiority missions, interdiction missions, or both. The Air Force would then need to support only two different types of aircraft in this theater.

CONCLUDING REMARKS

A concept of operations is offered suggesting how each of the major components of sortie generation—fuel, munitions, aircraft, and base kits—can be improved or modified to increase mobility. This

operational concept directly supports U.S. military strategy for Southwest Asia, which in turn would better support U.S. national strategy and objectives.

Providing air assets with greater mobility will not be easy or inexpensive, but this study should provide the reader with some food for thought. Some measures are quite inexpensive, such as using common hinges in aircraft access doors; other measures are quite costly, such as redesigning avionics. Further, much reliance must still be placed upon host nation support in the region. Drawing upon the expertise of maintenance personnel and the logistics community would aid the Air Force in defining its near and long-term options more substantively. Bladders, mobile mooring buoys, portable pipelines, OBOG equipment, self-starting aircraft, matured avionics, lighter base kits, fewer types of aircraft—these and other mobility aids that have been suggested offer potential that should be explored in a systematic fashion by Air Force planners and programmers. Southwest Asia has placed some unique demands upon the Air Force and these demands must be met to support U.S. military and national strategies.

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